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A HISTORY OF THE

BRITISH MARINE TESTACEOUS MOLLUSCA,

DISTRIBUTED IN THEIR NATURAL ORDER.

MOLLUSCA TESTACEA MARIUM BRITANNICORUM.

A HISTORY OF THE

BRITISH MARINE TESTACEOUS MOLLUSCA,

DISTRIBUTED IN THEIR NATURAL ORDER,

ON THE

BASIS OF THE ORGANIZATION OF THE ANIMALS;

WITH REFERENCES AND NOTES ON

EVERY BRITISH SPECIES.

BY

WILLIAM CLARK.

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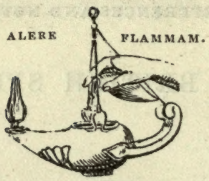

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TO THE

INHABITANTS OF EXMOUTH,

IN TESTIMONY OF HIS SINCERE WISHES FOR THEIR WELFARE,

AND FOR THE PROSPERITY OF THEIR TOWN;

AND ALSO

IN ACKNOWLEDGMENT OF THE UNVARIED KINDNESS

WHICH THEY HAVE EXHIBITED

TOWARDS THE AUTHOR AND HIS FAMILY

IN THEIR VISITS TO THAT LOVELY LOCALITY

DURING THE LONG PERIOD OF FORTY-FIVE YEARS,

THIS VOLUME

IS

RESPECTFULLY DEDICATED.

M347639

PREFACE.

IT has long been the fashion to present the reader with a prologue; which, however, I have observed, of late years, has become shorter and shorter. The utility of this practice is questionable, as the body of the work includes all that can be said in a preface, and by it we forestall the pleasures of expectation; besides, be it good or bad—and the author is frequently not the writer—it often unjustly decides the fate of a book, causing a bad one to be read, or a good one to be thrown aside; nevertheless I have in some measure complied with an old custom, by giving a few preliminary remarks in the introduction to the classification.

It will be observed that some of the families and genera of the Cephalopoda and Pulmonifera have been admitted into the sketch of the classification to complete the chain of the Molluscan series; to enter on their consideration forms no part of the plan of this work, which relates exclusively to the *British* Marine Testaceous Mollusca.

In some instances "nobis" is attached to the name of well-known species; this has been done, not from any desire to assume credit for the labours and disco-

veries of others, but simply to markeither that we have made some alteration in the nomenclature of the species, or that we have included under the name forms hitherto regarded as distinct.

Many of the memoirs have been admitted into the 'Annals of Natural History,' but as it would occupy about four years to have the remainder of them inserted in that excellent work, I have determined to print the whole at once in a collective form, and the Editors of the 'Annals' have liberally accorded me permission to reprint those which have appeared in the pages of their journal. My reason for making this arrangement is, that, at my age, it would be almost presumptuous in me to calculate upon being able to watch the publication of my observations during such a long period as four years.

I can entertain no doubt that my work is very defective, and, on such a subject, it would still be so, if I were to bestow the labour of another half century upon it. Were it at all probable that I might re-examine the whole matter, with the advantage of having first impressions defined and corrected by intermediate study, I should probably not have chosen this desultory form of publication; but if any justification of such a course be required, I have at least the opinion of Professor James Forbes to support me. That eminent philosopher, in his excellent 'History of Norway and its Glaciers,' well observes,—

"But a pretty long experience in such matters has convinced me that they act wisely and well, who, having used their opportunities to the best of their power,

communicate the results of their observations to the world without waiting for a period (never perhaps to arrive) when they may themselves have the credit of completing and perfecting them. It is better, whilst the freshness of recollection is undimmed, and the mind is in a position to draw a correct parallel between older and quite recent observations, and thus to give our descriptions the necessary development, to throw into them whatever there may be of value in our peculiar experience or habits of investigation, and frankly to invite our fellow-labourers to do in our stead what we would gladly have done but for some inevitable want of health, leisure, or opportunity. Were this course more generally followed in the sciences, both of observation and experiment, I am persuaded that by grasping at less we should attain more—even in personal reputation—and should unquestionably advance the interests of knowledge."

Norfolk Crescent, Bath,
November, 1854.

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ERRATA, CORRIGENDA ET ADDENDA.

Page 16, line 5, *for* and term *read* and term one of.
„ 36, „ 19, „ $\frac{1}{1}$ *read* $\frac{1}{15}$ to $\frac{1}{25}$.
„ 42, „ 19, 20, *for* the *A. striata*, which is the *A. patelliformis*, *read* the *A. striata*, which is a mere form of the *A. patelliformis*.
„ 54, „ 35, *for Lima subauriculatus read Lima subauriculata.*
„ 123, „ 11, „ rectum *read* intestine.
„ 128, „ 30, 31, *for* BRIMACULATA *read* BIMACULATA.
„ 131, „ 1, *for* the branchial artery *read* the branchial artery or vein.
„ 135, „ 28, „ as it has many features of the *Myadæ* and *Anatinidæ*, *read* as some authors say it has many features of the *Myadæ*.
„ 168, „ 10, Having written to Professor Ed. Forbes in Feb. 1849, on what I conceived to be the improper association of *Lutraria* with the *Mactridæ* instead of being placed with the *Myadæ*, he replied thus:—

"Craig's Court, Feb. 6, 1849.

"My dear Sir,—I quite agree in all you say about *Lutraria*, and shall keep your letter for the Appendix. So entirely did I agree in the view you take, that I sent the MS. to be printed with the *Myadæ*. The printers, however, mislaid it, and I was forced to put it in the old place.

"Believe me, dear Sir, with many thanks,

"Most sincerely yours,

"*Wm Clark, Esq.*" "EDWARD FORBES."

„ 246, „ 31, *for* in the Articulata *read* in the annelidan Articulata.
„ 247, „ 17, „ van *read* rear.
„ 296, „ 31, „ *Chemnitzidæ read Chemnitziæ.*
„ 310, „ 20, „ branded *read* brindled.
„ 331, „ 16, „ *tenebra read terebra.*
„ 444, „ 22, 23, *Dele* the words "the cause has perhaps been its anomalous aspect."

BRITISH MARINE TESTACEOUS MOLLUSCA.

CLASSIFICATION.

It will be convenient, with reference to this work on the British Marine Testaceous Mollusca*, that a synopsis of the classification of the whole tribe should be submitted, accompanied by a short analysis, that the incidents and position of any particular family may at once be examined. Most naturalists have their own plan of distribution with respect to natural order; perhaps, then, I shall not incur the imputation of an unmeasured presumption, if I venture to offer a sketch of mine, founded on forty years' sedulous investigation of our indigena. I have not the vanity to suppose that my scheme is superior to the methods of my brethren; but it is novel, and exhibits, as I think, a progressive advancement of animal organization and harmony of arrangement from the beginning of the class to its termination, by which groups of similar affinities are insensibly united as far as is possible, and succeed each other, on the basis of external and internal anatomical considerations.

These memoirs are the result of numerous visits to the

* The main object of this work is the description of the animals of the *British marine testaceous Mollusca*, and though a few of the freshwater and land families and genera are mentioned, it is only incidentally, and to fill up the outline of the British classification, but no account of their species will be given.

South Devon coast at Exmouth, where I have passed my leisure in the dissection and examination of the Marine Testaceous Mollusca. Nearly every animal has undergone, in a living state, my personal examination, and in many species often repeated. I have had my own dredger, and I may say with some confidence, that there are few individuals who have had better opportunities of observing the organs, their functions, and the habitudes of these varied and interesting animals, than myself. I trust that my dissections and investigations will give such a general, and in some measure particular account of their external configuration and internal anatomy as will suffice to furnish the younger students of this branch of zoology with some knowledge of their organization, and afford them sufficient aid to discriminate the organs of the animals, so as to let none pass without careful observation; for how many curious creatures, which perhaps only occur once in a lifetime, have been overlooked for want of such assistance, and are for an indefinite time lost to science! I speak with deep regret on this point; as in my earlier career I have neglected opportunities that have never occurred since, and which I have felt the loss of.

The anatomies of *Pholas dactylus, Teredo megotara, Dentalium tarentinum, Bulla hydatis,* and other desultory anatomical observations by myself, with references to M. Cuvier, the "principium et fons" of faithful comparative anatomy, will sufficiently explain the structure of the Acephala and Gasteropoda that have been treated of in these memoirs; which are by no means to be considered as strictly local ones. Though the species have been obtained from one vicinity, they will be found to give, I hope, a faithful portraiture of most of the animals of the entire class of the British marine testaceous Mollusca. There are, however, gaps which it has never been in the power of malacologists to fill up; but the hope of acquiring the rare desiderata ought not to be considered as forlorn. I have lately fallen in with very unexpected acquisitions which afford a practical illustration of the quotation—

> "Turne, quod optanti Divum promittere nemo
> Auderet, volvenda dies, en! attulit ultro."

I may mention that these remarks were scarcely dry, when I received from Exmouth a pine log full of magnificent *Teredo megotara* alive, which species I had not seen for thirty years, and enabled me to supply the anatomy of the *Teredines*. And in 1852 I reaped a splendid crop of rare desiderata, which I had almost despaired of. The gleanings of the harvest still remain, and will amply repay the labours of the energetic naturalist.

We have given no figures of the animals or shells, and only occasionally in the text, short notices of the hard parts; but we have supplied this want, by referring to the excellent and recently published 'British Mollusca,' by Professor Forbes and Mr. Hanley, of which we will observe, that no malacologist can dispense with this *vade mecum*, wherein will be found delineations, and copious descriptions of the shells of every animal mentioned in our work, with figures of many typical animals, and we have added references to those British species that have escaped our researches. Sir Walter Scott tells us, that nature having denied Mr. Croftangry a pencil, he endeavoured to make words answer the purpose of delineation;—I almost think, though fancy may be equally expansive in both cases, that if one has any general knowledge of the subject, a particular description of any of the variously formed objects of nature would ensure as good a distinctive resemblance as if drawn pictorially from life; the only exception is the human race, in which nature having arrived at the extreme limits of animal composition, illustrated by there being absolutely the same number and quality of the external organs in every tribe, the *chef-d'œuvre* of her works may, *perhaps*, be better expressed by portrait than by description; but all the other objects of animated nature, even in the same division, differ so exceedingly from each other, for example, in the present case, the *Mollusca*, that descriptive notes may possibly be preferable to artistical representation.

SYNOPSIS OF THE FAMILIES AND GENERA OF THE BRITISH TESTACEOUS ACEPHALA, GASTEROPODA, AND CEPHALOPODA, DISTRIBUTED IN SIX DIVISIONS, ON THE BASES OF SEXUAL ORGANIZATION.

First Division.

ACEPHALA PALLIOBRANCHIATA.

Hermaphrodita, sine concubitu.

TEREBRATULIDÆ	Hypothyris.
	Terebratula.
	Argiope.
CRANIADÆ	Crania.

Second Division.

ACEPHALA LAMELLIBRANCHIATA.

Hermaphrodita, sine concubitu.

** Mantle open, no tubes.*

ANOMIADÆ	Anomia.
PECTINIDÆ	Pecten.
OSTREADÆ	Ostrea.

*** Mantle open, no siphonal tubes or sessile.*

MYTILIDÆ	Mytilus.
	Dreissena.
	Modiola.
	Crenella.
	Pinna.
	Avicula.
UNIONIDÆ	Unio.
	Anodon.

**** Mantle open, tubes sessile or short.*

ARCADÆ	Arca.
	Pectunculus.
	Nucula.
	Leda.
	Galeomma.
	Lepton.

LUCINIDÆ	Lucina.
KELLIADÆ	Kellia.
MONTACUTIDÆ	Montacuta.
TURTONIADÆ	Turtonia.
CYCLADIDÆ	Cyclas.
	Pisidium.

**** *Mantle open, tubes short.*

CARDIADÆ	Cardium.
MACTRIDÆ	Mactra.
CYPRINIDÆ	Cyprina.
	Circe.
	Astarte.
	Isocardia.
VENERIDÆ	Venus.
	Pullastra.
DONACIDÆ	Donax.
	Ervilia.

***** *Mantle open, tubes long.*

TELLINIDÆ	Tellina.
	Syndosmya.
	Scrobicularia.
	Lucinopsis.

****** *Mantle closed, tubes short.*

ANATINIDÆ	Anatina.
CORBULIDÆ	Corbula.
	Sphænia.
	Pandora.
SOLENIDÆ	Solen.

******* *Mantle closed, tubes long.*

SOLENIDÆ	Solenicurtus.
GASTROCHÆNIDÆ	Gastrochæna.
	Saxicava.
	Venerirupis.
MYADÆ	Mya.
	Panopæa.
PHOLADIDÆ	Pholas.
	Teredo.
	Xylophaga.

Third Division.

GASTEROPODA
- LATERIBRANCHIATA.
- CYCLOBRANCHIATA.
- CERVICOBRANCHIATA.

Hermaphrodita, sine congressu.

* *Lateribranchiata.*

DENTALIADÆ ..... Dentalium.

** *Cyclobranchiata.*

CHITONIDÆ ..... Chiton.

*** *Cervicobranchiata.*

PATELLIDÆ ..... Patella.
Acmæa.
Pileopsis.
Calyptræa.
Emarginula.
Fissurella.
Puncturella.
Haliotis.

Fourth Division.

GASTEROPODA
- PLEUROBRANCHIATA.
- CRYPTIBRANCHIATA.
- PULMONIFERA.
- PARS-PECTINIBRANCHIATA.

Hermaphrodita,—congressu.

* *Pleurobranchiata.*

PLEUROBRANCHIDÆ..... Pleurobranchus.

** *Cryptibranchiata.*

APLYSIADÆ ..... Aplysia.
BULLIDÆ ..... Bulla.
Bullæa.
Otina?

**** Pulmonifera.*

Limneadæ	Limnea, &c.
Limacidæ	Limax, &c.
Helicidæ	Helix, &c.
Conovulidæ	Conovulus.
	Pedipes.
	Carychium.

***** Pars-pectinibranchiata.*

Holostomata.

Pteropodidæ	Spirialis.
Trochidæ	Trochus.
	Phasianella.
	Scissurella.
	Valvata.
Vermetidæ	Cæcum.
	Turritella.

Fifth Division.

Gasteropoda pectinibranchiata.

** Holostomata.*

Bisexual.

Cyclostomatidæ	Cyclostoma branchiferum terrestre.
	Acme branch. terrest.
Paludinidæ	Paludina.
Neritidæ	Neritina.
Littorinidæ	Littorina.
	Assiminia.
	Rissoa.
	Truncatella.
Tornatellidæ	Tornatella.
Heterophrosynidæ	Jeffreysia.
	Barleeia.
Pyramidellidæ	Chemnitzia.
	Eulima.
	Aclis.
	Stylifer.

*** Subcanalifera, vel ecanalifera, et subproboscidifera.*

PELORIDÆ	Scalaria.
	Ianthina.
	Natica.
	Lamellaria.
	Velutina.

**** Canalifera, convolutifera, et proboscidifera.*

ALATIDÆ	Rostellaria.
MURICIDÆ	Murex.
CYPRÆADÆ	Cypræa.
	Ovula.
	Marginella.

Sixth Division.

CEPHALOPODA DIBRANCHIATA.

Bisexual.

OCTOPODIDÆ	Octopus.
	Eledona.
DECAPODIDÆ	Loligo.
	Sepia.
	Sepiola.
	Spirula.

SYNOPSIS OF THE GENERA IN NATURAL POSITION.

Hypothyris.	Cyprina.	Patella.	Littorina.
Terebratula.	Circe.	Acmæa.	Assiminia.
Argiope.	Astarte.	Pileopsis.	Rissoa.
Crania.	Isocardia.	Calyptræa.	Truncatella.
Anomia.	Venus.	Fissurella.	Acme.
Pecten.	Pullastra.	Emarginula.	Tornatella.
Ostrea.	Donax.	Puncturella.	Jeffreysia.
Mytilus.	Ervilia.	Haliotis.	Barleeia.
Dreissena.	Tellina.	Pleurobranchus.	Chemnitzia.
Modiola.	Syndosmya.	Aplysia.	Eulima.
Crenella.	Scrobicularia.	Bulla.	Aclis.
Pinna.	Lucinopsis.	Bullæa.	Stylifer.
Avicula.	Anatina.	Otina ?	Scalaria.
Unio.	Corbula.	Limnea, &c.	Ianthina.
Anodon.	Sphænia.	Limax, &c.	Natica.
Arca.	Pandora.	Helix, &c.	Lamellaria.
Pectunculus.	Solen.	Conovulus.	Velutina.
Nucula.	Solenicurtus.	Pedipes.	Rostellaria.
Leda.	Gastrochæna.	Carychium.	Murex.
Galeomma.	Saxicava.	Spirialis.	Cypræa.
Lepton.	Venerirupis.	Trochus.	Ovula.
Lucina.	Panopæa.	Phasianella.	Marginella.
Kellia.	Mya.	Scissurella.	Octopus.
Montacuta.	Pholas.	Valvata.	Eledona.
Turtonia.	Teredo.	Cæcum.	Loligo.
Cyclas.	Xylophaga.	Turritella.	Sepia.
Pisidium.	——	Cyclostoma.	Sepiola.
Cardium.	Dentalium.	Paludina.	Spirula.
Mactra.	Chiton.	Neritina.	

If these positions are correct—and we have endeavoured to test them by the examination of near three hundred animals, all of which are confirmatory—we shall have placed the whole division of the Testaceous Mollusca on the sound basis of natural position. It is scarcely necessary to remark, that the subarrangement of the families, genera, and species, in their respective divisions, is of minor moment, and may almost be committed to the *ad libitum* of the naturalist; all that is necessary is, to collect similar objects, and deposit them, with-

out the hopeless attempt of a rigid, natural, precessional and sequential progression.

We almost think these facts and views go far to determine that the true progressive course of the essential order of nature of the class Mollusca, indeed of every other *distinct class* of animated nature, is within our reach, and that what we look for, depends on the more or less perfection of the reproductive system in each well-characterized group of the four grand types of the animal kingdom, in all which, if closely examined, we think the progressive advance of generative organization is sufficiently apparent.

ANALYSIS OF THE SYNOPSIS.

First Division.

Acephala palliobranchiata.

I have removed this section of the Acephala from its position at the head of the bivalves, to which I think it has no pretensions. I consider it a distinct inferior group forming the passage from the Ascidiæ and Cirripoda to the Acephala lamellibranchiata; by its pallial branchiæ it has relations with the Ascidiæ, and with the Cirripoda through the long convoluted cilial buccal appendages, which, though not articulated, in consequence of advanced animality, still prove its connection with that tribe. If the Palliobranchiata have the sexes distinct, as some authors have stated, the position I now place them in, with the strict hermaphrodite Acephala, would not be correct, and in harmony with my sexual distribution; but I believe that these views of bisexuality in the bivalves are erroneous, and the causes that have led to them are those mentioned in the anatomy of *Pholas dactylus* under the head of the "reproductive organs."

The Brachiopoda are very rare British productions: I have only met on the southern coasts with the minute *Argiope cistellula*; but the *Terebratula caput serpentis* and the *Crania anomala* have been taken in North Britain sufficiently plentiful to determine their anatomical structure. I refer for an

account of the animal of the *T. caput serpentis* to the 'British Mollusca,' and for other general observations to Professor Owen's paper on this family in the first volume of the 'Zoological Transactions.'

Second Division.

Acephala lamellibranchiata.

The animals of this group are strict hermaphrodites, though it is said that in some of them the sexes are distinct. We dissent from this view, and have assigned in another place our reasons for not concurring in this opinion.

The anatomy of the internal organs of the entire tribe as to generalities is so similar, that it scarcely affords sufficiently decided generic distributive points; my anatomies of *Pholas dactylus* and *Teredo megotara* confirm this position; I have therefore had recourse to an arrangement which combines both internal and external organs, to assist the distribution of this numerous class into convenient groups. A divisional order has been attempted on ligamental bases of internal or external position; but it has been found so unstable and arbitrary, that if strictly followed, the most incongruous species would be associated: for instance, *Mactra solida* would march with *Anatina prætenuis*, and the *Cardia* with the *Saxicavæ*. The disposition of the adductor muscles has been tried, and appears to be delusive and unsatisfactory, as most, if not all, Lamarck's *Monomyæ* have two adductor muscles, though the volume of one is much greater than the other. We think the only true *Monomyæ* are the *Pholadidæ*, as we have shown in the memoir on the anatomy, and these are *Dimyæ* with that eminent zoologist.

The teeth and foot as general guides are so variable as not to be available; the best of these aids is perhaps the greater or less closure of the mantle; this last we have adopted. It appears then that the animals cannot be allocated in a continuous natural order with perfect satisfaction by any of these modes: all that can be done by those who make use of such assistance, is to throw the tribes, genera, and species

together by the best mode that agrees with their composition.

It has long been the fashion, without any particular good reason, to commence the Acephala with *Pholas, Teredo,* &c., and to terminate them with the *Pectines, Ostreæ,* and *Anomiæ,* &c. I admit, as regards the essential points of natural order, that it is not very material whether *Pholas* and *Teredo* stand first or last in the scale. But in the classification I have adopted, which is founded on the progressive advancement of the reproductive organs, and having removed the Brachiopoda, which custom has placed at the head of the bivalves, to a position of less pretension, it has become necessary to invert nearly the usual order of arrangement, that animals of similar relations may be associated. This change entirely hinges on, and is the result of, the transference of the Brachiopoda from the position they have so long occupied; otherwise the ancient distribution would have been nearly as satisfactory. But the false position of the Brachiopoda, according to our views, has admitted of no alternative.

In conformity with these observations, the *Anomiæ, Ostreæ,* and *Pectines* naturally follow the Brachiopoda with which they have relations, and are succeeded by the *Mytilidæ,* &c., and brought, according to the intervening genera of the synopsis, to the *Gastrochænidæ*; the remaining families of the *Myadæ, Solenidæ,* and *Pholadidæ,* are thus placed at the head of the list, and form a very natural group; and I think that their decidedly higher organization — I particularly allude to the *Pholades* — and superior functions, as those of excavation, together with the compound structure of their shells, as is evidenced by the complication of the accessorial appendages as well as the consideration of the increased importance of the siphonal tubes and the enveloping mantle, bring them by these advances in composition into closer connection with the Gasteropoda than with the Ascidiæ, in the vicinity of which they have been placed from their muscular siphonal sheaths and closed mantle, which have been considered to bear a resemblance to the coriaceous envelopes of those animals. We have no difficulty in admitting *Venerirupis* into the family of

the *Gastrochænidæ*, though, by the teeth, it is allied to the *Veneres*, but we consider the character of the teeth of very inferior value to the closed mantle, which points out its natural position. *Teredo* terminates the Acephala and passes them to the *Dentaliadæ*, our primary family of the Gasteropoda, agreeably to the indices that are pointed out in the last page of the anatomy of *Teredo*.

Third Division.

GASTEROPODA
- LATERIBRANCHIATA.
- CYCLOBRANCHIATA.
- CERVICOBRANCHIATA.

The animals of this division are strict hermaphrodites without congression. The *Dentaliadæ* are the Lateribranchiata of the synopsis, of which family I have already given in the 'Annals of Natural History' a detailed anatomy; they have claims which appear not to be ill-founded, to stand as the first family of the Gasteropoda, from the connection between them, by the position of the branchiæ, with *Teredo*, the last family of the Acephala. The *Chitons* are the Cyclobranchiata. The *Patellæ*, *Acmæa*, *Pileopsis*, and *Calyptræa* are the Cervicobranchiate patelloid forms with a single non-symmetrical branchial plume; and *Fissurella*, *Emarginula*, *Puncturella*, and *Haliotis* are in the same Cervicobranchiate category, but differ from the first patelloid group in having two symmetrical branchial leaves.

Fourth Division.

GASTEROPODA
- CRYPTIBRANCHIATA.
- PLEUROBRANCHIATA.
- PULMONIFERA.
- PARS-PECTINIBRANCHIATA.

In this division there is an important advance in sexual arrangement; pure hermaphroditism is abandoned, and that of mutual congression has succeeded. The families are the *Pleurobranchidæ*, *Aplysiadæ*, *Bullidæ*, *Pulmonifera*, *Pteropodidæ*,

and *Pars-pectinibranchiata*. The first four carry branchiæ, or respiratory network in particular cavities of the back and neck; they all swim or float, except the *Limacidæ* and *Helicidæ*. It is necessary now to state why the Pteropoda do not constitute with us a separate class; their anatomy is so nearly identical with the hermaphrodite Pectinibranchiata of this division, that I have preferred placing them in conjunction, as they have the same sexual characters, rather than letting them remain in a false position, between groups of the Acephala and Gasteropoda, both of which are strict hermaphrodites, or intercalating them between the bisexual Gasteropoda and Cephalopoda, an equally inconsistent situation. The term *Pteropoda*, inferring that the foot, or locomotive, is formed like wings, and fixed more or less around the neck, does not, we think, militate against these animals being considered modified *Gasteropoda*; in like manner as the *Trachelipoda* of Lamarck, that have them under the neck, which is only a modification of the foot, that in many tribes occupies the entire length of the body. The wings of the *Pteropoda* are little more than broad membranous extensions of the anterior lateral portions of the foot to assist natatory locomotion on its natural element. The *Pleurobranchidæ* are fully noticed hereafter, and the *Aplysiadæ* are too well known to require any remark. The *Bullidæ* are a difficult family, many of the animals being very minute, and some have never occurred to any naturalist. We have preferred depositing the *Velutina otis* of authors,—Mr. Gray's *Otina,—ad interim* in this family, rather than amongst the *Conovuli*; at the same time, it is as probable it may belong to them, especially if it has not a gizzard. The distinguishing character of most, if not all, the *Bullidæ*, is the testaceous hard gizzard, in respect of which our opinions are not changed, of its being in some shape or other the invariable concomitant of this group; but we admit that in the minuter species it is so exceedingly small as easily to escape attention; we have found it so in *Bullæa punctata*, and only succeeded in finding it after several examples had been examined. It is possible that some of the species may have strong coriaceous gizzards, but in every *Bulla* and *Bullæa* that we have observed

it has always been found of a testaceous substance; for these reasons, though we have doubted, we now think that the *Bulla hyalina*, the *Amphisphyra* of Lovèn, may be a true *Bulla*.

Bullæa, an undoubted branch of this family, is copiously illustrated in our account of *B. aperta*, and by recent full descriptions of *B. pruinosa*, *B. catena*, and *B. punctata*, originally published by us more than twenty years ago, in vol. iii. p. 339 of the Zoological Magazine.

With respect to the *Conovuli* it has been said, that except *Carychium*, they are bisexual. We do not think so, as, besides their close connection with the *Helices* by the respiratory structure, we observed in more than twenty examples of the *Pedipes bidentatus* that all had well-filled ovaria. We believe they are congressional hermaphrodites; at least for the present we consign them as members of that reproductive character.

In consequence of the curious discovery, if it be substantiated, which is related in the chapter on the *Trochidæ*, that all the Pectinibranchiata, with *circular multispiral* opercula, hitherto considered bisexuals, are like the *Helices* hermaphrodites with mutual congression, the *Trochidæ*, including the genus *Valvata*, and the new family of the *Vermetidæ*, containing the genera *Cæcum* and *Turritella*, are admitted into this division. It seems, however, inexplicable why the strictly circularly operculated Pectinibranchiata should have the generative system of the *Helices*, and that all the others, of whatever shape the opercula may be, otherwise than circular, should be bisexuals.

Though the other hermaphrodites, with mutual congression, as the *Limneadæ*, *Limacidæ*, and *Helicidæ*, are admitted into our main line, it is impossible to place them therein satisfactorily; they are an aberrant group; nevertheless they form amongst themselves a closely connective line. The remaining hermaphrodites are the marine *Pleurobranchus*, *Aplysia*, *Bulla*, *Bullæa*, and *Otina*? These are another aberrant tribe admitted into line, but equally intractable as the last, yet they are pretty closely allied to each other. It appears then, that the general bond of consentaneity between all the families of

this division, and which plants them in it for ever, after our method, is their mutual hermaphroditism.

Some malacologists isolate these discordant groups from the systemic line, and term them *Opisthobranchiata,* from the heart being anterior to the branchiæ, in opposition to the *Prosobranchiata,* which have the heart, in the greater part of the Gasteropoda, posterior to the respiratory organs; this arrangement causes *Pleurobranchus, Aplysia,* and *Bulla* to enter into line after the *Cypræadæ,*—a more unnatural position, we think, —at least it is an isolated one,—than that we have adopted; and as there are other inconveniences in this plan, we have preferred, however incongruous and aberrant they may be with what follows, or precedes, or with themselves, to deposit them in the general line after the *Patellidæ*; and we are further induced to adopt this arrangement, as they are thereby at once brought within the limits of an important sexual scheme, which we think more conducive to a sound natural position than the posterior or anterior relation of the heart to the branchiæ. Nature herself is here discordant, and will not allow us to symmetrize her works as the squares of a chess-board. This is a vain idea, and however often repeated, will as signally fail as the hopeless tasks of the *Belides.*

The Nudibranchiata, which have neither external nor internal testaceous appendages, do not come within the scope of our work,—they are only mentioned as a numerous molluscan tribe; their position as hermaphrodites is in the Third and Fourth Divisions.

The Tunicata, comprising the *Ascidiadæ,* although they have some points of alliance with the Mollusca, we do not consider entitled to range with that class.

Fifth Division.

Gasteropoda pectinibranchiata.

Bisexual.

The genera *Cyclostoma, Acme, Paludina, Neritina,* the *Littorinidæ, Tornatellidæ, Heterophrosynidæ, Pyramidellidæ, Peloridæ, Alatidæ, Muricidæ,* and *Cypræadæ* are probably all

bisexual, and so largely mentioned hereafter, that extended analytic remarks are not required. We will only point out the curious fact that all the *Pyramidellidæ* have the eyes immersed at the internal bases of the tentacula, and the apex of the shell is, I believe, always more or less reflexed on the succeeding volution: these two points will invariably detect the Chemnitzian animal; the tooth also is of excellent value when present, but as the shell is as often without as with it, it is not always available. *Chemnitzia*, though a proboscidal animal, seems to have some alliance with the amphibious pulmoniferous *Conovuli* and the land *Carychium*.

Though the family of the *Cerithiadæ*, with its genera *Cerithium* and *Aporrhais*, in which some British species are deposited by authors, has no place in our method, it is proper to make a few remarks on it. We propose hereafter to show that the *Cerithium reticulatum* of authors is an elongated *Rissoa*, and that the *C. adversum*, from its spiral operculum, is also a probable *Rissoa*: we think *C. metula*, a *Cerithiopsis* with some, is an elongated Murex, ranging with our *Murex tubercularis*. It has been stated that the muzzle of *C. reticulatum* differs from that organ in the *Littorinæ* and *Rissoæ*; I am unable to discover a tangible difference, and think that the animals are in every respect the prototype of each other.

As for the *Aporrhais pes pelecani*, which has sometimes found its way into the *Cerithiadæ*, it will be seen that it has little alliance with it, for we shall prove, in our family of the *Alatidæ*, one of Lamarck's groups, to which it is transferred as *Rostellaria pes pelecani*, that it is a nearly strict muricidal animal.

We think the family of the *Cerithiadæ*, even as regards exotics, is altogether conchological and artificial; it is probable many of its animals will turn out simple Rissoideans, and many, elongated *Murices*.

Sixth Division.

Cephalopoda dibranchiata.

Bisexual.

These singular and highly organized animals are distributed in two families: the *Octopodidæ* include the genera *Eledona* and *Octopus*; the *Decapodidæ, Loligo, Sepia, Sepiola* and *Spirula*: they all creep and swim. They are elaborately and anatomically described and illustrated by M. Cuvier in his memoirs, and by Professor Owen in the second part of the second volume of the 'Zoological Transactions.' We have merely mentioned these animals to preserve intact the chain of the synopsis. To attempt to add novelty to this almost exhausted subject would be a vain and fruitless labour.

This is a most aberrant group, and cannot be placed in line; they are the most advanced in composition of the yet discovered undoubted Mollusca; but there appears so large an hiatus between them and the class they terminate, that they can only be considered an anomalous lateral branch.

I have now finished a limited analysis of my method of the distribution of the British marine testaceous Mollusca. I am led to think the sexual arrangement natural and well-founded, as it cannot fail to have been observed that as the generative influences are more or less perfect, there is a corresponding energy and activity. If we cast a glance at the strict hermaphrodites, as the Acephala and Patella tribes, we find them either fixed or of the most limited locomotion; but as soon as the generative structure is improved, the animals become more lively and locomotive. This view is exemplified in the hermaphrodites with congression, for instance, in the natatory Gasteropoda and Pulmonifera; but when bisexuality is established, there is an evident increase of motion, functions, and, I may say, even of intelligence and structural composition. And lastly, on arriving at the most highly developed generative influences that can attach to the Invertebrata, we see an energy and activity that even exceed those qualities in some

of the vertebrate animals,—I instance the powers and locomotion of the Cephalopoda.

In conclusion we observe, that Nature has put a veto on any arrangement that shall be exempt from anomalies and incongruities; we must look at her largely as a class, with a few well-marked divisions, and not be too sensitive about utopian details of strict natural order. We are prepared to expect that the present scheme will follow the fate of every other system of classification that has preceded it, however great may be the authorities from which they have sprung. It is universally admitted that the most accredited plans are unsatisfactory, and I venture to predict, that to the end of time our successors will make the same remarks. Mathematical nature is not an attribute of this sphere; the votaries of that condition must seek for it

"..... extra flammantia mœnia mundi."

The synopsis of the genera, we again impress it, shows the impossibility of such an arrangement. We have here perhaps as much connective harmony as the Mollusca can receive. We do not say that there may not be transpositions and certain modifications of the genera to meet the particular views of malacologists, but the general outline may perhaps be as near the truth as the subject will admit of. If zoologists demand a natural line, they cannot have it without excluding from the grand main various families. In consequence, our classification, at certain points, presents incongruities that no art can arrange satisfactorily, but they are brought as near to each other as Nature will allow of. We must submit, as we cannot alter her laws and dispositions. The fact of our line not according a direct totality of strict affinities, proves that Nature cannot be thus arranged, because the Supreme Creator, whose handmaiden she is, has not invested her with the power of effecting a symmetry beyond what she has accomplished.

ACEPHALA PALLIOBRANCHIATA.

A few general remarks on the Palliobranchiate Mollusca, in addition to those in the synopsis of my classification, will be a useful reference in respect of this class of acephalous animals. I include in the general matter on the Palliobranchiate Mollusca, the meagre notices and references to the very few recent species of this tribe that now exist; these, however, contain all that is known of the organization of this numerous group of one of the epochs which preceded that in which our orb has been described as "rudis indigestaque moles." For the reasons stated in the analysis of the Mollusca, I have reversed the position of this section of the bivalves, and made it the alpha instead of the omega of the Acephala.

These animals derive their appellation from the respiratory apparatus forming a vascular network on the substance of the mantle, instead of being provided with the distinct symmetrical, usually double laminæ, on each side of the body of the Lamellibranchiata; they are the Brachiopoda of Lamarck, and form two families in respect to the British indigena,—the *Terebratulidæ*, containing three genera and four species, and the *Craniadæ*, with only one genus and one species.

This class of Acephala formed the great mass of the Mollusca in the palæozoic ages, as is proved by the almost infinite variety of their fossils, which are more numerous than all the other groups of Mollusca united. But in these latter days it would appear, from the excessive rarity of living species, that the race has nearly become extinct, or live in unapproachable depths; I believe that not half a dozen species have ever been examined, and we can scarcely hope that several anomalies in the structure of these animals and their shells will ever be explained; no comparison can be made — the same animal must be observed. The British collector cannot hope to possess more than five recent species, two of which, the *Hypothyris psittacea* and *Terebratula cranium*, may be considered almost

beyond acquisition; the only chance is, that a fortunate hit may be made, and these rare productions brought to light from the deep sea beds.

That the animals of this tribe are of inferior organization to the lamellibranchiate bivalves, is, I think, shown by their invariable fixity of habitat. By-the-by, it is said that in this family, and also in the *Ostreadæ*, the sexes are distinct: if this be so, how can the genial influences pass? for we must presume some sort of congression. Is it contended that the germs of vitality are committed, at hap-hazard, to the waves? I cannot concur in this doctrine. I believe all the bivalves are strict hermaphrodites, that is, without congression, and contain within themselves the elements of bisexuality.

I return from this digression to make a few more observations on the value of the palliobranchiate organization. In addition to the fixed state, it may be added, that in it the circulation is more simple, the motive power consisting only of an auricle on each side, without a ventricle. The spiral ciliated arms, though not articulated, in consequence of their hollow structure producing an equivalent flexibility, are to me sufficient evidence of an alliance with the Cirripoda; and I think the structure of the respiratory apparatus equally conclusive that these animals are closely related to the *Ascidiæ*. Let us examine the upper valve of *Crania*, fixed as it is to the animal only by muscles. I can consider it in no other light than as the analogue of the operculum of the *Balani*, for the protection of the animal, and support and regulation of the issue of the long, spirally-coiled, ciliated, tentacular buccal appendages; and I think that the longer or shorter internal opercula of the *Balani*, which are imbedded, with a limited movement, in a cartilaginous mass, are only tantamount to the internal apophysary processes of such of the Palliobranchiata as have them; and for those which are destitute of these peculiar supports, the issue of the long spiral arms is regulated, as in the pedunculated Cirripoda, which have not the moveable opercula of the *Balani*. The spiral arms in both species of *Balani*, as well as in the Brachiopoda, besides tentacular and buccal functions, may also serve as the muscular

agents for the opening and closure of the valves, in aid of other special muscles.

It may be said that these views are far-fetched, or imaginary; but if naturalists would seriously consider that the operculum of the *Balani* is of the nature of an apophysis for a particular purpose, they can only come to the conclusion that such an appendage can have no other use but for the support, issue, and regulation of the buccal tentacular arms. If it is asked, what is the use of the apophyses of the Palliobranchiata? the same answer only can be given. These subumbonal blades appear in the *Pholades* and *Teredines*; their use is the same as the processes in the Palliobranchiata, and the opercula of the Cirripoda, for the support and regulation of certain organs of the animal.

With the exception of the genus *Hypothyris*, the shells of these animals are invariably covered with punctures or foramina, which would appear to give them a slight cross with still inferior classes. There is nothing peculiar in the reproductive organs; a similar disposition of them is seen on the mantle of *Anomia* and in some of the *Pectines*. In this group the animal is deposited in its shell differently from the Lamellibranchiata; the larger or convex valve, though uppermost, is really, with respect to the animal, the dorsal one, and the under valve the ventral one; an approach to a similar position of the animal may be observed in *Anomia*, *Pecten* and *Ostrea*. In the Palliobranchiata the nervous system is more sparingly developed; they have lost the knotted spinal cord of their remoter relatives, the Cirripoda, which in them is disposed in detached ganglions, the result of the change they have undergone in the plan of their organization; and for the same reason, the articulation of the spiral arms has disappeared, and is replaced by their tubular flexibility, the use and form of the organs still remaining the same in them as in the Cirripoda.

I think enough has been said to show that the palliobranchiate bivalves are of inferior organic structure to that of the lamellibranchiate Acephala. We refer those who are desirous to be informed of what is known of the organization

of this interesting and almost undeveloped class, to Professor Owen's Memoir, vol. i. of the 'Zoological Transactions,' and to M. Deshayes and Milne-Edwards's comment and observations, vol. vii. p. 305–329 of their second edition of Lamarck's 'Animaux sans Vertèbres.'

We conclude by repeating our opinion that the Palliobranchiata are not of co-ordinate organization with the Lamellibranchiata, but an inferior group, having many connective links with the Cirripoda. Our notes are unavoidably scanty, from the dearth of materials and difficulty of the subject. We have done: as facts cannot be stated, hypothesis ought not to supply their place.

ACEPHALA LAMELLIBRANCHIATA.

I shall now give an outline of the anatomy of the lamellibranchiate bivalves, to serve as a standard of comparison. The internal structure of the animals of this division is less complicated than in the Gasteropoda, and presents such a similarity throughout the whole class, as to render it unnecessary to give more than a detailed account of the organs and functions of the animals, without reference to a particular species. This generalization will include all the genera of the subsequent groups of the Acephala that may be noticed, except that especial care will be had to note any essential departure from the general organization in any particular genus or species.

The circulation, including the respiration, is complete; it usually consists of a pair, of infinite variety of outline, of suboval vascular plates, fixed under the mantle on each side the body; these are composed of a network of branchial tubes, and are each furnished with an arterial and branchial vein, the one to receive the blood from the venæ cavæ for aëration, and the other to convey it through the auricles to the heart, to be again transmitted into the system; the artery of each lamina is situate at the upper margins of the branchiæ, at

their junction with the body, under the mantle, at the dorsal range, and is of concurrent length with them; each branchial vein coasts the margins of its respective lamina. The motive power of the circulation is a heart, which is a simple ventricle, and two symmetrical, oblong auricles, one on each side of it; it is placed subcentrally on the dorsal range, rather nearer to the posterior half, and with the auricles embraces the rectum or intestine, which thus apparently passes through it. But this is not the case with every bivalve, though the major part of them are thus constituted; the *Ostreæ*, *Arcæ*, and some few others are exceptions. The heart and auricles are nearly pellucid, of the thinnest texture, and apparently of feeble power; the auricles have valves to prevent a reflux of the blood; they are usually situate at their junction with the heart, sometimes at the point where the branchial veins unite with them, and they sometimes are found at both contacts. The inspirations and expirations are each about seven or eight in a minute. The heart gives forth at least two aortic branches, which ramifying furnish arteries to the system, and at their invisible termini the venous reflux has its origin, and by continual anastomoses and inosculations, in their progress to the arterial centre, terminate in one or more trunk veins or venæ cavæ, which effect a coalition with the branchial artery.

Though the circulation is what is called complete, it may be liable to interruptions, divergences and retardations; that is, if the opinion of some zoologists, Mr. Garner amongst them, is well founded, that the whole of the blood is not returned to the body in each circulation, and a part of it, from various organs, passes to a set of veins which are concentrated anteriorly, on each side the dorsal range, in an elongated sinus, extending to and under the pericardium; and that these veins, by small lateral internal sacs, ducts or orifices, pass the secretions, or fluids they have distilled, to the mantle, in aid of structure and coloration, for the use of the ova and other organs; and that branches from this fasciculus of veins, after the depuration of their contents, transmit the blood into the branchial artery; it is also said that other portions of the

venous blood enter by branches into the principal branchial vein and auricles, and is sent into the circulation without being transmitted to the branchiæ for aëration. Part of these views I can confirm, as far as relates to the spongy excretory glands at the anterior end of the sinus above alluded to; they are visible in *Pholas dactylus*, and conspicuously in *P. parva*; their uses are fully described under the title of excretory organs of *P. dactylus*. As to a portion of the blood being returned to the heart without receiving the dose of oxygen, I have not had it in my power to verify that fact.

From this statement it would appear, that in some of the bivalves, if not in all, the circulation is not without interruption, and that there is a particular one for the special purpose of providing the necessary secretions. With regard to these points I am inclined to think, that the veins of each organ form and supply the secreting glands for itself, in its own immediate vicinity; for instance, the liver, the bile for the stomach; the ovarium, the mucus for the ova; the byssal gland, the filamentous fluid; the mantle its own pigments; also that thin membrane which is the external duplicature on the shell, springing from its margins, and spreading more or less on all shells, as well as on some of the exposed soft parts of the animal, producing what is termed the pilose skin, epidermis, and exterior ligamental covering. There is a difficulty in supposing that all the secretions are elaborated and distilled from a mass of veins collected in a particular cavity, and produce the peculiar secretion for each organ, conveying it thereto by a separate sac or distinct duct. I can scarcely believe that such a concentrated *olla podrida* can act harmoniously, and produce simultaneously, from a fasciculus of veins deposited in the same reservoir, mucus, pigments, carbonate of lime, &c.

With respect to the digestive organs, the mouth — there being no head, eyes, nor tentacula — is a large, plain, transversely oval aperture, covered by the mantle, and is placed towards the upper part of the anterior range, having on each side of it a pair of palpi, which appear to be both of a tentacular and respiratory nature, and perhaps assist the cilia that clothe the branchial laminæ to beat and divide the water in

aid of the extraction of the vital principle. The mouth leads by a short œsophagus into the stomach, concerning which, the elastic stylet, and the tricuspid membrane or stomachal attritor, we refer to the account of the digestive organs of the *Pholas dactylus*.

The food of the bivalves appears to be animalculæ and soft crustacea. From the stomach, which is of suboval or pear-shape form, the intestine plunges obliquely into the lower part of the body, amidst the ovarium, and forms 2–5 or 6 convolutions, and at the last turn it ascends to the dorsal range, and, as rectum, discharges at the posterior extremity, either into an anal tube, as in the *Pholades*, *Myæ*, &c., or without one, fixed externally or floating free, as in the *Pectines* and *Anomiæ*. The liver is usually a large, green, granular viscus, on the dorsal region, almost enveloping the stomach, into which it pours the bile by several ducts or orifices.

The reproductive organs scarcely require mention, as they are largely noticed in the anatomy of the *Pholas dactylus*, above alluded to. We may, however, say, that all the bivalves are strict hermaphrodites without congression. The ovarium varies greatly in form and consistence at different seasons; in winter it has generally the aspect of homogeneity, but when under the stimulus of the genial months it becomes tumid, flaky or granular, and as fecundation advances the congeries of ova appear in progressive development until the term of gestation is complete, when they are ejected and deposited on various marine receptacles. These animals, though termed self-sufficient, have doubtless mixed up with their ovaria the male influences, which are apparently minute pear-shape bodies, only discoverable in the genial season, containing a glairy fluid, which may be to communicate the vital spark. In some genera, as *Anodon*, *Mytilus*, and a few others, the ova are deposited for a time amongst the network or interspaces of the branchial laminæ, in which they are further developed, and become testaceous, when they are finally ejected.

In reference to the secretions already spoken of elsewhere, we will only observe that the mantle envelopes the entire animal; its edges are often ciliated, and the posterior end

extended into siphonal tubes; the external surface lines the shell, and is the constructor thereof, by the exudations of calcareous matter from its vessels; the inner surface embraces the body, and is hung—and this observation introduces those on the muscular system—by some inconsiderable muscles; but the grand supports of its position, in all bivalves, are the adductor muscles which pass through and suspend the body by being fixed to each valve, and when detached leave cicatrices, termed muscular impressions, which have been applied to assist generic and specific determinations. It is said that in the *Anomiæ, Ostreæ,* and *Pectines,* there is only one subcentral muscle: this is a mistake; as in those genera, as well as in the *Mytili* and some others, I have found a second muscle, though often of very inconsiderable volume, under the beaks; we may therefore consider the monomyal and dimyal characters as untenable. The mantle in the *Anomiæ, Ostreæ,* and *Pectines* is entirely open from the beaks, and destitute of siphonal tubes; in others, as in *Lucina, Mytilus,* &c., it is more closed, and shows only two sessile orifices; in the families of the *Veneridæ* and *Mactridæ* a still further closure is apparent in that membrane, which in them is produced into two short tubes; in the *Tellinidæ* it forms rather long slender siphons; and finally, in the *Pholades, Lutrariæ, Myæ, Gastrochænæ,* and the *Saxicavæ,* it is entirely closed, except a pedal orifice, and is often produced into two long tubes, either soldered on each other or inclosed in a retractile sheath; the lower siphon is called the branchial, the upper the anal one; the former conveys water to the branchial cavity and expels it. We do not believe the doctrine that the water enters by one tube and is discharged from another; we think it is admitted both from the branchial siphon and pedal orifice, and expelled indiscriminately from those apertures. In many genera both, and in others only one of the siphons are provided with valves at their orifices, to regulate the entry and expulsion of the water, and, with one or more circles of tentacular filaments, to capture and transfer the animalculæ into the branchial cavity: on this point see our observations on the *Pholades.*

The foot is a very variable organ, implanted usually in the subcentral lower portion of the body; when at rest, in many families it represents a pedicle, with an elbow doubled up at its side, but in action it becomes instantly straight, pointed, flexible, and extensible more or less in all directions, full of energy and activity. Many of these animals have at the bend at the pedicle a byssal groove, from which tenacious filaments are spun, that enable the animal to fix itself in situations where such action is required, and detach again, which is always effected by the extraction of the byssus from its origin, leaving it fixed at the last locality, and when necessary, spinning another with great celerity; not as a matter of course, but in case circumstances, as currents and rapid tides, require such aid.

As to the nervous masses, they are few and scanty, a single ganglion being placed above the mouth, the other posteriorly; but they are connected with each other by filaments, from which threads ramify to all the muscular supports of the body, particularly those important ones the adductors, the foot, siphonal retractors and minor muscles: the muscular composition of these organs appears in their textures under every imaginable superficial, horizontal, and perpendicular angle.

As the shell or hard parts of the bivalves are essential elements of their composition, I am bound to give them some consideration; I shall however only make a few remarks on the ligament and cartilage, as well as the teeth; the former is chiefly intended, aided by the teeth, to maintain the valves in a symmetrical position, when the cartilage is unbent, by the relaxation of the adductor muscles. The cartilage is the great source of elasticity, arising from the impacted mass of fibres of which it is composed, that give its substance almost the appearance of homogeneity. When the animal closes the shell by the retractive action of the adductors, its spring is then bent, and on relaxation the valves are opened to the extent the adductors are relaxed; but if they are divided by the knife, the elastic power of the cartilage opens them to the fullest extent, at least until they are stopped by the beaks and umbones. Whether the cartilage is termed external or in-

ternal, or half within and half without, its *modus operandi* in either case is as I have described; and the ligament, as far as its power extends, acts precisely the same. The ligament is always exterior in reference to the cartilage, often covers it, and is fixed to the external margins of the shell, whilst the cartilage rests on the internal marginal surfaces and callosities that act as a fulcrum, which in many species is aided by an apophysis, pit, or excavated internal process. The teeth, with which a large portion of the bivalves are furnished, are strictly of a calcareous nature; and I am not aware that they have other uses than literally to act as a hinge, and to assist the ligament and cartilage in strengthening the closure of the valves and maintaining their proper position.

In some genera where there are no teeth, an accessorial ossicle clasps the two valves as an equivalent; and in those that are entirely mute, the power of the adductor muscles is invariably increased. I have stated, in the preceding paper, that the teeth, ligaments, cartilages, and cicatrices of the muscles, afford, from their variableness and instability, no efficient assistance in forming a continuous natural order; therefore these appendages of the shell will receive no further consideration in any remarks I may make on the natural arrangement of the families of the Acephala; they may, however, assist in specific distinction, and as accessories and make-weights in balanced investigations.

I will now make a few observations on the lacunose doctrines that have lately been promulgated by the French and Belgian naturalists, which we believe have their origin in M. Cuvier's celebrated *Aplysia* case, in which it is stated that the *vena cava* or great branchial vein is perforated so as to permit its contents to mingle with the fluids of the abdominal cavity. M. Cuvier considered this structure so unusual, though he communicated it to his friends, that he hesitated to make it public for many years, until he had by every possible test satisfied himself of this almost unnatural phænomenon, which he declared to be the most extraordinary he had ever met with. I think, if that illustrious naturalist had lived in our days, he would have seen cause to change his opinion, and that

the strange appearances he observed were the result of the contraction of the muscular fillets of the *vena cava* rupturing the extremely thin and almost invisible films of the interspaces of the vein, in consequence of the shock the animal received from sudden death, by spirit, boiling-water, or any other mode of asphyxia.

I have already stated, in the observations on the Lamellibranchiata, that some malacologists are of opinion, that in the Conchifera all the blood conveyed by arteries to the system is not carried back to the branchiæ for aëration by a direct vascular apparatus, and that a portion of it is again passed into the system either through the auricle and heart or otherwise, without having undergone the respiratory process of purification. But the moderns have gone far beyond these venous irregularities, and assert that in every *molluscum*, from the Tunicata to the Cephalopoda, though the blood enters the system by arteries, a part of it reverts to the respiratory centre, by *lacunæ*, cavities, canals, hollows, and fissures, not by veins and walled tubes, which exist in the tissues of the flesh of the animal; and that the blood, by meanderings, exudations, and filterings through these labyrinthine sinuosities in its passage for respiratory aëration, is mixed with the abdominal and alimentary cavities and their fluids, from whence they are collected by what are called branchio-cardiac vessels, and transmitted to the heart.

With respect to this process I doubt it altogether, and make the same observation on it as on the *Aplysia* case above, that the excessively fine vascular membranes are at their larger terminations attenuated and often destroyed by contraction and lost by collapse, and become in the animal killed by violence so amalgamated with the tissues as to be invisible, and thus their sites have the appearance of *lacunæ*, &c. I believe this to be the true solution of the apparent absence of venous ducts, and that, though of extreme tenuity, they exist in the live animal.

Nature always acts with order and consistency, and it is difficult to suppose she would so far depart from these attributes, after having constituted a particular set of vessels to

convey the blood throughout the system, and another visible elaborate apparatus to eliminate the vital element, that she would stop in the midst of her career, and, instead of a set of vessels to convey it back to the branchiæ for oxygenation, substitute and allow the stream of vitality to find its way through a mixture of cavernous sinuosities, and percolate amidst the ordures of the visceral contents to the mouths of the branchio-cardiac vessels, to pass it to the respiratory mechanism to repair the usual exhaustions and adscititious impurities of its passage.

Neither of these opposite views can be verified in the living animal, and the examination of the dead one is equally unsatisfactory, because uncovered sinuous canals may appear to exist in the tissues; but who can say that the excessively thin walls may not have vanished by contraction attendant on the peculiar mode of death, leaving only the sinuosities of their sites?

The above remarks are confined to the circulation of the blood. I fully admit that in many of the Mollusca, aquiferous canals and pores exist in the tissues of the foot and its pedicle, and other organs for the admission of water to assist in promoting the tension of those organs in aid of locomotion; but I do not believe that the water enters the visceral regions except by the mouth, unless in consequence of a rupture of the partition-membrane between the cavities of the foot and the abdomen; it has been stated that the *Lucinæ* are instances of the water passing through the foot into that cavity.

For these reasons we repudiate, as contrary to nature and all analogy, the doctrine of even a qualified lacunose system for the blood circulation; that is, of its being sent by arteries to all parts of the organism, and returned partly by walled vessels, and partly by sinuous canals worked out of the parenchyme.

And in the tribes of inferior organization to the Mollusca, we consider, however imperfect the mechanism of the sustentation and circulation may be, that both these functions are distinct, and in no case confounded; we believe that nine-tenths of the matter that has been advanced by authors on

these points are little better than hypotheses, and rest on unsound demonstrations. It is well known that the mind, deeply intent on the examination of the very minute objects of natural history, when jaded and exhausted by the pressure of high microscopical powers, often deceives itself, and from preconceived impressions, idealizes and fancies it sees objects that have only an imaginative existence, and strongly distorts real ones through optical illusion.

We admit that in the lower Invertebrata there is no mechanism for sustentation, circulation, and respiration, of the complex and advanced character of the Mollusca, as heart, auricles, arteries, and veins; but though these inferior grades do not present the strict homologues of these organs, we think that there are in them analogical substitutes, which rescue the simplest of these beings from the confusion and unnatural admixture of organs and functions that have not the community which authors have ascribed to them.

Though a heart and circulatory vascular structure cannot be demonstrated in the minuter, and even in some of the largest of the Radiata, we nevertheless believe that they exist, as well as a distinct visceral cavity and canaliferous walled recipient for the aliments, and that the two mechanisms are not otherwise connected, except by the former receiving from the laboratories of the latter the influences and elements to invest the blood with the power of sustaining life, after it has received the impress and interchange of the gases with those of the exterior or interior fluid aërating elements by endosmose or exosmose, and thus establish the vital principle. And further, we are of opinion that muscles and nerves are present in the lowest of these organisms to excite motion and sensation to an extent commensurate with their wants.

On this head we cannot help quoting a passage of ours in the 'Annals of Natural History,' vol. v. p. 161, N.S., in a paper on the Foraminifera:—

"On the question of the nervous and muscular influences, which Lamarck only admits, as independent of sensation and interior sentiment, in his apathetic animals, amongst which are the Polypi, I must be allowed to make a few observations,

to explain my reasons for not concurring in the views of that great naturalist. Lamarck contends that sensation, or interior sentiment, does not exist in the lower animals, and that in them all movements arise from irritabilities excited by external impressions: I demur to this doctrine, and firmly believe that no created being can exist and exhibit evidences of vitality, by motion, without having implanted in it a certain degree of sensation or interior sentiment, by the influence of which the nervous and muscular powers are put in action. I grant that external causes may produce motions and contractions, not I think by exciting an irritability independent of sensation, as Lamarck terms it, but by the agents and after the manner I have just stated.

"It will be admitted that the sensations in the lower animals, which are the origin of the nervous and muscular influences, are of the most subdued qualities; and though the points of departure of the nerves, and the muscular supports dependent on them, may not be discernible by the most powerful instruments, still I believe that they exist, and produce those movements which are observed in the monad as well as in man. In the superior and larger animals, we can perceive the causes of these influences and admit their existence, because they are apparent; and why not in the smallest, though they escape our vision? In the nearest fixed stars we can observe their proper motions, but in those which are plunged in the deeper regions of the sphere, these motions, though we may presume that they undoubtedly exist, are inappreciable. Why may we not apply a similar reasoning to the doctrine of the sensations or interior sentiment, and the resulting nervous and muscular influences, being implanted in the lowest as well as the highly organized animals, according to their several structures, and not consign vast classes to exist without sensation? It appears to me that the lines of separation between apathy, sensation, interior sentiment, and intelligence, as laid down by Lamarck, are erroneous and arbitrary. I believe that apathy in its strict sense, as applied to animals, does not exist; and I repeat, that the most inferior created animal being is not without that portion of sensation or interior sentiment, and

its concomitant nervous and muscular influence, that produces the motions which are the tests of vitality. I may state that Lamarck does not admit the distinction of intelligence and instinct; he very justly considers the different degrees of what is called instinct, in animals, as only subdued intelligences consequent on their imperfect organs, when compared with the highest standard—man."

The contents of the visceral cavities or walled ducts, whether they consist of solid food or chyliferous fluid, have precisely the same function as in the higher animals, that of sustentation; and whatever may be the nature of the blood fluids which fill the vascular apparatus of every living being, and all have one, we think they ought to be termed the true blood, as it always flows in parietal contractile tubes, arteries, or veins, and never in excavations called *lacunæ*, burrowed in the parenchyme of the animal. These *lacunæ* do not apply to visceral matters; they are simply aquiferous canals to give tone to the various muscular organs of the Invertebrata, and not for the circulation of blood. When we say that a vascular circulating and respiratory system exists in the monad as well as in man, we admit that these organs are often simplified to the extent of the requirements of the various tribes. We do not contend that the elaborate structure of the higher invertebrates obtains in the radiate organisms; but we think that if there be not a heart receiving blood by auricles, and conveying it by arteries and veins through a general circulatory and respiratory apparatus, there are in the simplest beings equivalent conditions, and that the typical heart of systole and diastole agency is often represented in the vascular mechanism by receiving from muscular contractibility and relaxation a power which gives a sufficient impulse to the blood to secure its enrichment and aëration.

And further, with respect to the circulatory apparatus of these inferior organisms, though its tubes and cavities may not have the gradual decrease and increase of the arteries and veins as in the higher animals, nor consist of an afferent and efferent set of vessels, we consider that the substitutes of these organs are sufficiently supported by analogy, if the blood is

transmitted for the nourishment of the body through tubes and variously-shaped walled canals or cavities, though they be neither typical arteries or veins; we go further, and believe that in many of these beings a blood circulation may be as effective through a single walled canal as by a more complex arrangement, and thus receive the necessary aëration, which in most of the lower Invertebrata is probably cutaneous and effected by endosmose, and that in those animals in which the ambient element can only be admitted into visceral cavities, it is oxygenated by exosmose.

ACEPHALA PALLIOBRANCHIATA.

TEREBRATULIDÆ.

Having already mentioned most of the incidents of this family, I have only to add, that it consists of three genera, *Hypothyris*, *Terebratula*, and *Argiope*. None of the animals or the shells have occurred on the Devon coasts, except the *Argiope cistellula*, and that only in a dried state.

HYPOTHYRIS, Phillips.

H. PSITTACEA, Chemnitz.

H. psittacea, Brit. Moll. ii. p. 346, pl. 57. f. 1, 2, 3.

We can only refer to the first vol. p. 150, of the 'Zoological Transactions,' for Professor Owen's account of this animal. The shells of this genus are never punctated. A very doubtful British species.

TEREBRATULA, Bruguière.

T. CAPUT SERPENTIS, Linnæus.

T. caput serpentis, Brit. Moll. ii. p. 353, pl. 56. f. 1, 2, 3, 4.

The valves of this genus are always punctated, and particularly so in this species; it is taken plentifully on the Scotch

coasts. We refer to the second vol. p. 355, of the 'British Mollusca' for a description of this animal.

T. CRANIUM, Müller.

T. cranium, Brit. Moll. ii. p. 357, pl. 57. f. 11; and iv. p. 257.

This species is said to have occurred in Zetland. The animal has not been observed.

ARGIOPE, Deslongchamps.

A. CISTELLULA, Searles Wood.

A. cistellula, Brit. Moll. ii. p. 361, pl. 57. f. 9, and iv. p. 257.

We have taken this species in the coralline zone, at Exmouth, with the animal in the shell, but perfectly dry; and all that is known of it is, that it has spiral arms supported by an apophysary process.

The present shell is quite fresh; it is of subquadrate form, pale brown colour, much more compressed than the Shetland specimens, and has the mesial groove more distinctly developed; still it is only a variety of the *Megathyris cistellula*, which M. Philippi states to be subject to much variation of outline. Axis et diameter $\frac{1}{1}$ unciæ. I have again recently taken from the coral zone of the South Devon coast, at Exmouth, in thirteen fathoms water, the *M. cistellula*, now *Argiope cistellula* of the 'British Mollusca,' the *Terebratula seminulum*? Philippi, which I believe has not been found so far south in the United Kingdom, except *fide Turtoni*, in Torbay; I am sure that Professor Forbes and Mr. Hanley will feel pleasure in the corroboration of the correctness, in this instance, of Dr. Turton's habitat: see the note in the 'British Mollusca,' vol. ii. p. 362. I have had on several occasions personal intercourse with Dr. Turton, and became the original purchaser of his collection of British shells, which, during my temporary secession from malacological pursuits, passed out of my possession; Dr. Turton also did me the honour of the dedication of his Manual of the Land and Freshwater Mollusca. Under

these circumstances, I consider it to be my duty, to say, in respect to the note referred to, that I am confident my old friend never intentionally led us into error; nor do Professor Forbes and Mr. Hanley state otherwise. The fact is, that Dr. Turton was a man of great simplicity, and so far from age giving an increase of caution, it appears, with him, to have had a contrary effect; if it were necessary, I could relate several curious and laughable stories of his being duped by the frauds of crafty shell-dealers. Whilst I admit that Dr. Turton lent too credulous an ear to the impositions of unscrupulous communicators, which has impaired our dependence on the habitats of various doubtful testacea recorded in his 'Conchological Dictionary,' I trust I have cleared the memory of my friend, to whom British conchology is much indebted for his care and nurture, from every suspicion of gross and indesinent error: we must not forget that Dr. Turton and the excellent Montagu fanned the flame of this branch of natural history when almost extinct, and its supporters were few and far between.

CRANIADÆ.

This family has one genus and one recent species.

CRANIA, Retz.

C. ANOMALA, Müller.

C. anomala, Brit. Moll. ii. p. 366, pl. 56. f. 7, 8, and pl. U. f. 2 (as *Norvegica*).

Animal with pale pink, fringed, spiral arms. The ovarium is red-brown, and deposited partially on one of the lobes of the mantle. It is taken plentifully in Scotland. It is to be hoped that some qualified northern or wayfaring naturalist will furnish science with a more extended account of it, and of the *Hypothyris caput serpentis*, as I apprehend it will be long before an additional recent species will occur.

ACEPHALA LAMELLIBRANCHIATA.

ANOMIADÆ.

The only genus of this family, *Anomia*, is one of the *Ostraceæ* of Lamarck's monomyal order, which cannot be maintained in its integrity; zoologists have long removed the *Mytilidæ* from it to the *Dimyæ*. It will be as well at once to state, that all the monomyal animals of that eminent naturalist are really *Dimyæ*. It will probably create some surprise when we say, that the only true *Monomyæ* are the *Pholades* and *Teredines*, as, we think, we have satisfactorily demonstrated in their respective anatomies. All other bivalve genera have two adductors; the anterior one in *Anomia*, *Pecten*, and *Ostrea* is of so small a volume, as almost to have escaped notice; and the great subcentral muscle in those genera appears of a size as if the two ordinary dimyal ones were amalgamated; still the anterior adductor exists, and if carefully searched for will be found under the beaks, pointed out either by a single minute cicatrix, or by a little group of five or six closely united, very small, muscular scars; this disposition of the cicatrices varies in all the genera, so does the main subcentral mass, as to shape and size. Careful dissections of the animals will show the muscular filaments adhering to the circumscribed area under the beaks; but in oyster-shells that have been exposed to the action of the sun and air, and vicissitudes of weather, the minute anterior adductor is perfectly visible. In the three genera we have mentioned, these muscles are of small size; they, however, in the next family, the *Mytilidæ*, though still small, have become more developed, and in the following one of the *Arcadæ* they have completely acquired the typical size and position, which is maintained in all the remaining families, until they reach the *Pholadidæ*, when they merge into a single medial adductor, both in the *Pholades* and *Teredines*.

Lamarck has made *Pecten* and *Lima* the types of the *Pectinidæ*, and *Ostrea* that of the *Ostreadæ*; so far we concur; but we must remove *Anomia* from the *Ostreadæ*, with which, though it has the relations of the great subcentral muscle, and absence of tubes, still there are closer ones, of a different character, with the Palliobranchiata and the *Pectinidæ*.

Though the characters of the great subcentral or posterior adductor muscle, the rudimentary, or no foot, and absence of siphons, are very decided ones, and common to this particular order or race, still it is not necessary that *Anomia*, *Pecten*, and *Ostrea* should on those accounts form a single family, any more than the *Veneridæ*, *Mactridæ*, and *Cardiadæ*, because they have distinct tubes, foot, and are strict *Dimyæ*; therefore these reasons, and those under each particular head, have determined us to constitute *Anomia*, *Pecten*, and *Ostrea* as distinct families.

Anomia then, with its single species, constitutes the family of the *Anomiadæ*, which we fix, according to our method, the first of the Lamellibranchiata, as it forms the decided point of passage from the Palliobranchiata, by its constant state of fixture, by a prolongation of the adductor muscle, through a perforation of the valve, to marine substances, either by a ligamentous or testaceous point of adherence; it also shows a similarity in the disposition of the ovarium on the mantle, and position of the animal in the shell. It will be observed that in this statement there is not a single point of community between *Anomia* and the *Ostreadæ*. Though *Anomia*, by the small byssiferous foot, and the very singular doubled-up structure of the branchial laminæ, shows a very intimate connection with the *Pectinidæ*; nevertheless, from its constant fixity, the perforated valve, ligamentous attachment, the texture of the shell, its proteiform shape, and the hinge, it cannot, without violence to established distinctions, be allocated with that group. I think I have adduced sufficient reasons to support the severance of *Anomia* from the *Pectinidæ* and *Ostreadæ*; and I consider that there are equally good reasons for the separation of *Pecten* and *Ostrea*.

ANOMIA, Linnæus.

A. EPHIPPIUM, Linnæus.

A. ephippium, Brit. Moll. ii. p. 325, pl. 55. f. 2, 3, 5, 7; and animal, pl. T. f. 2.

Anomia ephippium, *A. electrica*, *A. cepa*, *A. squamula*, *A. aculeata*, *A. striolata*, *A. punctata*, *A. cylindrica*, *A. tubularis*, *A. striata*, *A. fornicata*, *A. coronata*, *A. patelliformis*, *A. undulata*, Auctorum.

A. aculeata, Brit. Moll. ii. p. 332, pl. 55. f. 4.

A. patelliformis, Brit. Moll. ii. p. 334, pl. 56. f. 5, 6.

A. striata, Brit. Moll. ii. p. 336, pl. 55. f. 1, 6, and pl. 53. f. 6.

Animal subdepressed, with its periphery suborbicular; mantle circular, the upper portion, or the one forming the convex valve, of very thin and pellucid texture, except at the anterior margin, which is thick; and the under part, or that lying on the flat valve, is also thin, but has the appearance of being fleshy from having the ovarium soldered to it; both are clothed with a double fringe, which diminishes in breadth as it approaches the beaks, and passes round the aperture of the operculum, there throwing out cilia, and then is fixed under them. The outer circle of fringe consists of long, yellowish white, sharp-pointed tentacular filaments, which are, when undisturbed, continually protruded beyond the shell, and on the inner circle there are long and short cilia of the same colour distributed irregularly; but the colours of the fringes and their marginal areas vary from a mixed blotchy red to yellow or purplish brown. No ocelli can be detected. There are a pair of circular branchiæ varying from pale red to dark brown on each side of the body, with fine longitudinal and transverse vessels, presenting the appearance of a delicate network; the plates of each pair have a part of their outer surfaces double, and form circular open pouches, the upper part of which is well defined by the branchial vein: thus each single plate presents the aspect of two, and the two pair of branchiæ appear composed of eight plates; but the double parts can easily be placed in length, by the insertion of a camel's-hair brush in the hollows, and again be returned to the double

position. This curious configuration of the branchiæ is that of the *Pectines*, but not of the *Ostreæ*.

At the anterior side, which is easily known by being opposite the conspicuous anal tube—or if the shell is placed on its front edge, with the perforated valve to the right hand of the observer, it will be farthest from him—is situate the oval margined mouth with its large aperture, which is very high towards the dorsal range, and has around it two plain linear membranes that are continuations of the branchiæ, which at this point have become slender. These laminæ expand at each side the mouth into two pair of long delicate labia, fixed by the entire length of the longest sides, folding on each other; they are finely striated on both surfaces; the colour is light to dark brown. The foot is almost reduced to nothing; it is fixed to the body under the mouth, and is a small, yellow, obtuse, subcylindrical, pendulous, deeply-grooved organ, capable of spinning a byssus, which we have seen, and may serve to fix the animal in conjunction with the operculum.

It is strange that nature should have furnished this animal with a foot and byssal groove of so small a size as apparently to be of little use, unless we suppose it to have the power of freeing itself from the bodies to which it is attached; and this idea is by no means without the verge of possibility. It is known that the *Arcæ*, *Pectunculi*, and other byssal bivalves, can detach themselves from their fixed position by abandoning the byssus. May not the *Anomiæ* dissever the end of the adductor muscle from the calcareous operculum? This inference arises from the presence of a byssal foot, which would then have a *pro tempore* use, whilst the animal in a change of locality is again fixing itself. These ideas are fortified by the statement of our dredger, who affirms that he is constantly hauling up pieces of rock studded only with opercula: this fact is certainly no proof that the animals detached themselves, but it is a link in a chain which has a certain value. Nevertheless we are inclined to think the genus a fixed one for life.

The ovarium is an extensive, inflated, sinuated lobe, originating on each side the liver, coasting the body, and glued to

the lower half of the mantle; this organ has been mistaken for a large foot, but its soft, pulpy, granular composition shows that it is the organ of reproduction, and the milky humours arising from various pyriform membranes, in the genial season, which are only then discoverable, are probably the male organs of fecundation. The colour of the ovarium, as well as of the body in general, is very various; sometimes they are of a pure vermilion, and from that, passing into every hue of that colour, as well as into all the shades of yellow and pale red-brown. I have seen all these colours in groups of the *Anomia ephippium*, on the same *Pecten*; whilst in others all the objects on the same shell have maintained a uniformity of colour. The same discrepancies prevail in *A. aculeata*, *A. striolata*, *A. cylindrica*, and *A. squamula*. These differences, combined with the various markings, shapes, spines, ribs, and striæ, generally resulting from similar markings on the substances on which the shells are fixed, have doubtless been the cause of the multiplication of the species, as in all the varieties enumerated, not excepting the *A. striata*, which is the *A. patelliformis* of the 'British Mollusca,' the organs, as far as they have been examined, have not presented marked differences, except in colour. The liver is always of the various shades of green, placed under the beaks, at the centre of the dorsal range; the passage from the mouth to the stomach is a short gullet, and these organs are situate under, and partly surrounded by the liver; from it the intestine descends to the centre of the body, where it makes some turns, then ascends through it and the ovarium to the dorsal range, and issuing therefrom, passes behind the body and the posterior sinuation of the ovary, slightly attached to their membranes, and debouches at some distance from the base of the posterior ventral range, as an uncovered rectum.

In most bivalves the muscular impressions are supposed to assist specific distinction, but this idea is fallacious with respect to the *Anomiæ*. In this genus the circumscribed line in the convex valve contains the impressions of the muscular mass, which divides itself into three cicatrices, one by itself and the others on the right and left of it; these impressions

are never exactly of the same size, nor do they preserve their relative positions in any of the varieties, in consequence of the animal dividing the muscular mass into three fasciculi of fibres, varying in quantity, thus altering the shape and relative distance of one portion from the other; therefore these impressions are of little distinctive value.

Finally, as regards the animal, it may be observed, that in this singular unsymmetrical genus, even its organs display, like the shell, varieties of form; this arises from the entire animal being deposited in the convex valve; it only rests on the flat one, and the organs, in consequence, vary with the ever-varying figure of the upper valve.

I will now make some remarks on the various markings and aspects of the shells of the so-called British species, of which I have examined above a thousand. And as regards their general shape, they vary from all grades of subcircularity to every subtriangular form. I have seen on the same *Pecten*, on the shells of which genus the *Anomiæ* are oftener fixed than on any other, two individuals of the typical dirty-white *A. ephippium*, the one displaying its strictly squamous character, and marked not only with ribs, but the vaulted and arched spines of the *Pecten*; the other, in contact, without a rib or spine, and only showing the regular squamæ of increase. I have also seen the *A. ephippium* with half the transverse portion of the shell of a perfectly squamous character, and the basal half ribbed and spiny, and *vice versâ*. The same incidents are seen in the rosy purplish *A. cepa* and bright yellow *A. electrica* of British authors, which are mere deviations of colour from the type.

As for *A. striata*, otherwise the *A. undulata* of some authors, which is certainly the most aberrant form of the *A. ephippium*, the distinctness of which has been insisted on from the iridescent green colour of the inside of its valves, the radiating muscular impressions and the intense vermilion of the animal, I have to observe that in young specimens, of one and a half inch diameter, having the anastomosing radiating striæ found on the smooth insides of the *Pecten maximus*, I have noticed these characters to be by no means constant, having

frequently taken delicate, pale, dirty white-brown shells with similar markings, without an appearance of the green insides, and instead of the vermilion animal, they presented a pale yellow aspect; in addition, I have taken from rocks hauled up from the coralline zone, *A. ephippium* of 3½ inches diameter, with and without anastomosing striæ, and the insides varying from green to light brown and white; and I have little doubt that all the variations I have mentioned are those of the type, *A. ephippium*, which under no circumstances loses its characteristic squamous character.

With regard to the young or dwarf *A. ephippium*, *A. squamula*, *A. aculeata*, and *A. striolata*, grouped and crowded on the *Pectines*, I believe they are mere dwarf varieties of the type; these often adopt the markings of the substances on which they are fixed, and as often show a complete disregard thereto. I have seen shells combining all the supposed distinctive marks in one individual, in which the decided, smooth, glossy *A. squamula* has commenced the umbonal part of the structure, gradually in respect of the middle portion, gliding into the squamous *A. ephippium*, and dividing the basal part right and left, the one into the asperities of the *A. aculeata*, the other into the delicate smooth striulæ of the variety *A. striolata*. Nothing is more common than to see shells half *A. squamula* and half *A. ephippium*, and other admixtures of the characters of two or three supposed species. The last-named four varieties are also found at the roots of Algæ, but both in colour and the union on the same shell of each other's distinctive marks, they present the same incongruities and discrepancies as their brethren on the *Pectines*.

The *A. cylindrica* or *A. cymbiformis*, a variety of the *A. ephippium*, takes its hollowed appearance from embracing the roots of the Fuci; the *A. tubularis*, another variety of the type, has the margin of the aperture elongated, to suit its condition to some irregularity of the substance on which it is placed. The *A. punctata* is also a young *A. ephippium* with papillæ-like eminences on the convex valve, and corresponding depressions on the flat one, arising from similar markings on the substances on which they are fixed. I do not know the

A. fornicata and *A. coronata* recorded by Mr. Bean, but I learn from the 'British Mollusca' that they fall into the same category with those I have named.

I have now noticed all the varieties of *A. ephippium* termed by authors *species*, and there is certainly no sculpture on them of such a decided character as to denote specific distinction; therefore all the markings, shapes and colours of this Protean genus being inadequate for the foundation of species, we must have recourse to our sheet-anchor—the malacology of the animal—to assist our determinations; and after the examination of a great number of individuals, of nearly all the recorded species, we have come to the conclusion that they are varieties of the only British one of this genus, the *A. ephippium*, which, by the identity of its organs with the pseudo-species, puts a veto on a longer continuance of the dismemberment of its unity, by allowing forms based on mere varietal distinction to march *pari passu* with it, and which have no solid grounds for aspiring to higher honours.

PECTINIDÆ.

The British *Pectinidæ* comprise only the genus *Pecten*, which is a part of Lamarck's monomyal order. The genus *Lima*, usually associated with *Pecten*, is merged in it as a section. Our reasons for distributing the *Anomiæ*, *Pectines*, and *Ostreæ* in three families, are given in our remarks on the *Anomiadæ*, wherein the essential points of the differences of the organs and habitudes of their animals are shown; we may add, that the texture of the shells of this group has lost the leafy imbricated character and become firmer, solid, and of a more porcellanous nature; their form is infinitely more symmetrical than in either *Anomia* or *Ostrea*. A careful examination of the descriptive notes of the animals of the *Pectinidæ* will show that they are not of the same family as either of the other groups.

PECTEN, Bruguière.

** Shell firm, solid, of a porcellanous texture.*

P. OPERCULARIS, Linnæus.

P. opercularis, Brit. Moll. ii. p. 299, pl. 50. f. 3, pl. 51. f. 5, 6, and pl. 53. f. 7.

Animal suborbicular, thick, lentiform; this shape results from the support given to the organs by the powerful central circular adductor muscles; the colours are very variable, white, pink, fawn, orange and brown; the body, with the amalgamated ovarium, is a compound of flake-white meandering lines, spots and blotches, and its conical termination is of the palest vermilion to the intenser hues of that colour; it descends from the dorsal to the ventral range, on the anterior side of the great subcentral muscle. The mantle is thin, except at the fleshy margins, and open throughout, with the exception of a short dorsal area; there is not a trace of siphons; it would be too large for the shell if it were not doubled on itself and fixed a little within the duplicature to the shell by very slender muscular pallial threads. At the folding a cord-like margin springs, but the true mantellar margin floats loose, and is considerably within this line; both are furnished with 2–3 rows of irregularly deposited, conical, white, pointed cirrhi of three different lengths; those of the inner circle are tinged with brown; the outer or fixed range has the longest filaments, and in addition 35–40 subglobose ocelli that have pearl-coloured pupils within black circles; these vary in size, and extend at equidistances throughout the peripherial range to the auricles.

The foot springs from the body just below the palpi; it is yellowish white, subcylindrical, of small volume, deeply cloven or furrowed, and scoop-shape at the termination; it appears to have no locomotive use, and only to be the vehicle for producing a byssus for occasional fixation, especially of the young animal. I have seen most of the species thus fixed.

There are a pair of subcircular branchiæ on each side, varying in different individuals to all shades of the colours above

named, deep, and of similar depth, very thin and delicately reticulated; the outer surfaces of each pair, as in *Anomia*, with which *Pecten* has alliances, are doubled on each other, and form circular pouches when in natural position; but these duplicatures can be put straight and again returned. In connection with them, on each side, are a pair of broad short palpi, rounded at their extremities, fixed laterally to the body and to each other, so that they fold as the leaves of a book; they are smooth without and well pectinated within, of a yellow-brown or pale orange colour; each pair is united with the other around the mouth by two cordons of 5–6 short, dull orange, fimbriated cirrhi; the mouth is between them, and passes by a short œsophagus into the stomach, which is immersed in the extremely dark granular liver, and contains the usual stylet and attritor or tricuspid membrane; the intestine plunges to the bottom of the body, and again ascends to the dorsal line passing around, embraced by the heart and becoming fixed to the posterior side of the great muscle, debouching at nearly the ventral level. The ovarium is mixed up with the body; its surface is studded with ova, and the vermilion termination contains a milky fluid which may be the fecundating influence; it is only in the genial season that this appearance is seen. We have no faith in the doctrine of the bisexuality of the Acephala; in many it is impossible for a contact to ensue.

The locomotion is effected by the animal with the posterior end in front suddenly opening and closing the valves, which action, as we have repeatedly witnessed, produces a motion as rapid as that of a Lobster or a Sepia.

This species being more universally distributed than any other, may be considered as the type of the British *Pectines*, in which the organs present almost an identity of form. The specific differences consist chiefly in the colours, and in the arrangement and size of the cirrhi of the margins of the mantle, together with a general but unmistakeable aspect in each species, which affords the practised eye sufficient distinctive characters; but if the younger student is at a loss to appreciate the animal specialties, he will obtain much aid from

the conchological indices, which afford valuable corroborative assistance.

At Exmouth this species is taken in the coralline zone in great abundance; so much so, that they might be, perhaps, preserved in jars, if their delicacy did not prevent sufficient firmness, and would prove a more delicious morsel than the pickled oysters of the Italian warehouse.

P. VARIUS, Linnæus.

P. varius, Brit. Moll. ii. p. 273, pl. 50. f. 1.

The general structure and composition of this animal is so similar to that of the type, *P. opercularis*, that it will only be necessary to note the specialty variations. In this species, the reflected or inner free margin is, as to colour, marked with pale red or brown irregular blotches, with the edge fringed with a single row of thin, white, blunt filaments, which, though short, vary in length; the outer or fixed margin has at the innermost part, at equal distances, a row of long, conical, light yellow cirrhi; to these succeed 30–35 ocelli, which have more black and a less pearly appearance in them than in the type; and the outermost paraphernalia of this margin consists of two irregular rows of extremely fine, snow-white filaments of three lengths. The branchiæ are in all respects similar to the type, except in being of the palest drab; the body and ovarium, which is amalgamated with it, is of a pale yellow cream-colour, mottled with thick-set flakes, which have the aspect of ova; we are not sure if the vermilion colour ever appears in this species; all its organs are of a much more delicate, elegant and refined aspect than in any of its congeners of similar bulk. The intestine terminates by a short, white, slightly grooved rectum, spatulate at the end. The labia are pale fawn, and the two connecting foliated rows of fringe of light drab. The ovarium, or that part of the body constituting this organ, is at this season, August, full of ova, and an opake red milky fluid, as in the type. We here repeat, that we do not believe in the bisexuality of the Acephala, by which term is meant that each individual is either male or female.

The foot emits a powerful coarse byssus, which cannot be detached without laceration of the body, but the strands are easily separated from the substances on which they are fixed; this is contrary to the usual plan of the Bivalves, which, when a change of locality takes place, is effected by drawing the byssus from that part of the foot-groove close to the body, and leaving it moored to the substance on which it was fixed: this operation we have witnessed even in confinement. This species is given as an example of the variation of specialties; all the others afford nearly as decided ones.

I trust that some northern observers will compare the *P. tigrinus*, *P. striatus* and *P. furtivus*, all of which we believe are identical, and communicate the result: if they are distinct, malacologists will have no difficulty in seizing the distinctive characters. Speaking conchologically, we should say that the three so-called species are only variations of the old *P. obsoletus* of authors, now styled *P. tigrinus*.

This species is either free, or adheres by the byssus to marine substances, but is not imbedded in them by the under valve, as in the *P. pusio*.

P. PUSIO, Pennant.

P. pusio, Brit. Moll. ii. p. 278, pl. 50. f. 4, 5, and pl. 51. f. 7.
P. distortus, Montagu.
P. sinuosus, Turton et Auct.

The body and ovary throughout are either intense vermilion, or of a uniform pale yellow-white, and not half white and half vermilion, as in *P. opercularis*; at least in *P. pusio* we have never observed this to be the case. The branchiæ are dull red-brown, and the palpi pale brown; there are two connecting rows of pale red cirrhous fringe around the mouth. The back or free margin of the reflected mantle has two to three rows of irregular, short, yellow-white, blunt filaments. The ocelli are larger, fewer, and more distant than in the type. The fixed or anterior marginal circle has a row of large, long, conical, pointed, yellow filaments, and in front of it two to three irregular rows of shorter cirrhi of different

lengths; the mantellar marginal areas are a blotchy mixture of fawn, yellow, pale red-brown, and lead colours.

This species comes much closer to the type than *P. varius*. From the great variableness of the colours in the same species, and the general similitude in the structure of the organs, it is sometimes difficult to seize the specific distinctions of closely allied animals; in such case we must call in aid the figure and markings of the shell, which being dependent on the disposition of the secreting glands of the mantle, cannot well be malacologically appreciated. This case strongly supports the views laid down in the paper on the *Littorinæ*, in the May 'Annals of Natural History,' 1850, wherein we strenuously contend for the examination of both the animal and the shell to ensure a true distinction of species, as when the soft parts do not afford sufficient characters, the shell may assist in resolving the difficulty.

This species is usually imbedded in masses of Flustra and old bivalves by the under valve.

P. similis, Laskey.

P. similis, Brit. Moll. ii. p. 293, pl. 52. f. 6, and (animal) pl. S. f. 1.

Shell suborbicular, depressed, but equally convex on both surfaces; the auricles are not greatly dissimilar, the posterior, however, is the smallest, their terminations are sometimes rounded and sometimes obliquely truncate. There is very little sculpture on either valve beyond the fine subcircular striæ of increase, and rarely there are faint traces of ribs, but the markings on both surfaces are very variable in figure and colour; they exhibit every combination of blotches of all hues, and sometimes a series of markings simulating radiating ribs so closely as to be difficult of detection; but these appearances, under proper optical powers and light, will be found to be in the test, with the surface quite smooth.

We have taken such specimens alive in the coral zone at Exmouth, from one of which are derived the notes on the animal. Diameter less than a quarter of an inch.

Animal of the same form as the shell, and as variable in its

colours. The mantle is pale yellow, furnished, as is usual in the Pectens, with a fixed and free margin; the latter is clothed with about twenty long, white, triangular, frosted cirrhi with shorter intermediates; from the minuteness and delicacy of the animal the filaments of the fixed margin were not detected; the free margin between the cirrhi is marked with blotches of all sizes, of the colours yellow, bistre, rufous, and black; the ocelli are 16–20 ashy circles, having in their centre a minute ring or pupil of a smoke colour. The branchiæ vary from light yellow to dark lead colour, but the very fine darker lines are generally relieved by intermediate lighter ones; they, like their congeners, have the lower part of the area of each gill-plate reflexed on the upper, forming subcircular pouches. The small foot, producing a byssus, is situate very high, almost immediately under the anterior dorsal margin, and varies from white to vermilion. These variations in colour of the shell and organs of the same species are one of the characteristics of the tribe. The foot appears to have little power of locomotion, but by spinning a byssus it produces a mooring apparatus. The animal, by flapping the valves, effects a rapid progression.

This very distinct species has been considered by some as the young of *Pecten maximus*, but the convexity of both valves negatives this idea. At all ages the *P. maximus* has the upper valve flat, with a concave area at the beak.

P. MAXIMUS, Linnæus.

P. maximus, Brit. Moll. ii. p. 296, pl. 49.

In this beautiful and well-marked species, both by the shell and the animal, the inner margin of the mantle has only a simple row of very short, white cirrhi; the fixed anterior margin has three ranks of filaments of different lengths not deposited in perfect serial order, the largest and longest are pointed, and on retraction become curled in a spiral form; all the cirrhi on the upper or flat valve are marked in the centre, from base to point, with a pale red-brown line, the under surfaces being white; the cirrhi of the convex valve

are pure white on both surfaces. The membranous marginal areas of the mantle are elegantly arranged in meandering lines of pale red, brown and yellow, forming various-shaped lozenges. When the valves are opened, and the mottled surfaces of the double margins of each valve are in conjunction, and the various circles of filaments and cirrhi fully exserted in a shallow basin of sea-water, it is scarcely possible to conceive a more beautiful and interesting appearance. There are two rows of sea-green ocelli relieved at one part of the circle by a black point, with the pearly pupils deeply sunk in their hollows; there is usually a large eye under each rib of the shell; the others are much smaller, deposited in a row under them; they all amount to about thirty to thirty-five. The branchiæ are small for so large a species; there are a pair of palpi on each side, pale drab or brown, laterally attached, folding on each other, subquadrangular, composed of twelve to fifteen strands pectinated on both surfaces, but more intensely on the inner; the buccal fringes are two rows of very bright red, well-foliated and branched fillets, which connect the palpi; the mouth is in the centre of them. The body, and the ovarium amalgamated with it, are of very small volume and usually white. The foot is snow-white, short, grooved, with a spatulate extremity. The liver is quite dorsal, black-brown, or an intense dark green. The brown suboval secreting glands on each side are as conspicuous in *Pecten* as in *Ostrea*.

We may observe, that in all the *Pectines* the mass of the organs is small, and appears scarcely commensurate with the area of the shell; perhaps the deficiency is made up by the mantellar extensible margins and cirrhi, which coast the periphery, being only interrupted by the very short ligamental area, from which point, on each side, they gradually increase in width and size to the centre of the aperture. The animal can effect a rapid progression by flapping together the valves, with the ventral margins in front and the flat valve uppermost.

This elegant and edible species, the Prince of the British Pectines, is frequently taken in the coralline zone at Exmouth.

Some malacologists think that the *P. niveus* of the Caledonian shores is a variety of *P. varius*; we believe from the shell it is distinct, but the animal must determine; it has not occurred on our southern coasts. The *P. tigrinus*, the *P. obsoletus* of authors, is frequently taken alive in Exmouth Bay; but it is a variety, though ribbed at the margin, of a smoother mould than the Scotch specimens, which from their variableness have been manufactured into three or four species, as before observed. The *P. danicus* is Scotch, and the *P. islandicus* probably spurious.

** *Shell thin and of vitreous texture, varying from a perfectly symmetrical to an oblique outline.*

P. FRAGILIS, Montagu et nobis.

Lima Loscombii, Sowerby.
—— ————, Brit. Moll. ii. p. 265, pl. 53. f. 1, 2, 3.

We have yet to learn why this animal has received the specific title of "*Loscombii*:" surely the far prior and more appropriate appellation of the excellent Montagu and other authors ought to be adopted. We do not understand the changing old accredited names for complimentary ones.

This animal presents no essential difference from that of *Pecten*; it is even difficult to appreciate the specialties, which only consist in the greater length of the three rows of the tentacular filaments of the mantle, which are long, close-set and numerous, of the various hues of pink and white. We have seen twenty of these animals alive; they exhibit the same character of the liver, branchiæ, palpi, minute foot, pink ovaria, of most of the *Pectines*; the ocelli in the minuter species are obsolete, but the rudiments of them are perceptible; the same kind of locomotion in the so-called *Lima*, as in *Pecten*, I have frequently observed when placed in sea-water, in a shallow dish, and is effected by opening and suddenly closing the valves, with the posterior end in front, and thus rapid progress is made. When the adductors are unbent, the animal protrudes the mantle and mass of filaments, which then appear too large for the shell; this is not so, as on the slightest disturbance all vanishes instantly within the valves.

The shell also only shows specialty-variations, the principal one being sometimes, not always, a more oblique outline; in it we observe the same character of the ligamental and cartilaginous areas, a similar disposition of the longitudinal ribs, and the greater or less emargination of the valve under the posterior auricle, for the byssus, by which they are all fixed at some part of their existence, usually when young, and becoming often free when adult. With these views, I am compelled to consider *Lima* as a superfluous genus, and merge it in *Pecten*; I cannot call the same animal both *Lima* and *Pecten*. The conchologists, perhaps some malacologists, will condemn these innovations; but the knowledge of the animal configuration gives me the moral courage to perform the necessary amputations, for the benefit and safety of the system.

This animal is rare at Exmouth at present, but was more plentiful some years ago; it is, with its only two congeners, the *P. hians* and *P. subauriculatus*, taken occasionally alive in the coralline districts. We have often seen it spin a byssus and fix itself. The animals of this section often collect and agglutinate in a mass minute nullipores, thus forming a nidus and harbour of refuge.

The following Pectens have not been observed:—

P. NIVEUS, Macgillivray.

P. niveus, Brit. Moll. ii. p. 276, pl. 50. f. 2; (animal) pl. S. f. 3.

P. DANICUS, Chemnitz.

P. danicus, Brit. Moll. ii. p. 288, pl. 52. f. 1, 2, 7, 8, 9, 10.

P. ISLANDICUS, Müller.

Vide Brit. Moll. ii. p. 303.

P. TIGRINUS, Müller.

P. tigrinus, Brit. Moll. ii. p. 285, pl. 51. f. 8–11.
P. striatus, Brit. Moll. ii. p. 281, pl. 51. f. 1–4; (animal) pl. S. f. 2.
P. obsoletus, Mont. et Turt.
P. furtivus, nonnull.

P. SUBAURICULATUS, Mont. et nobis.

Lima subauriculatus, Brit. Moll. ii. p. 263, pl. 53. f. 4, 5.

P. HIANS, Gmelin et nobis.

Lima hians, Brit. Moll. ii. p. 268, pl. 52. f. 3, 4, 5; and (animal) pl. R. under the name of *L. tenera*.
L. tenera, Turton.

OSTREADÆ.

One genus, with a single proteiform species, constitutes this peculiarly British family. *Ostrea* is the Lamarckian monomyal type. What has been said on the *Anomiadæ* and *Pectinidæ* renders further detailed remarks unnecessary. We will only observe, though the general form of the branchial laminæ is similar to those of the *Pectines*, that they are in their composition *very distinct*; the complete absence of the byssal foot is another important deviation, and in other respects it is eminently distinguished from *Pecten*; *Ostrea* is generally fixed by the under or convex valve, and has, if any, a very limited locomotion, whilst *Pecten* is almost always free, and can perform the most rapid leaps and movements.

OSTREA, Linnæus.

O. EDULIS, Ibid.

O. edulis, Brit. Moll. ii. p. 307, pl. 54, (animal) pl. T. f. 1.
O. parasitica, Auct.

Animal orbicular, subcompressed, of a pale drab colour throughout; mantle thin at the beaks, gradually thickening to the ventral range, entirely open, except a short dorsal area, and has no trace of siphons or sessile apertures; the margin is not reflected on itself as in *Pecten*; there are two rows of tentacular filaments springing from cord-like offsets of the margin; the front one is furnished with very thick, short, white, blunt cirrhi, disposed in a disorderly double line; the other is more within the shell, and has a simple series of short, pale brown filaments of different lengths; these are rarely seen exserted, from the habitude of the animal to keep the valves closed. The body, including the dark green liver with the incorporated cream-coloured ovarium, proceeds from the centre of the dorsal area on the anterior and posterior sides of the great subcentral muscle, at which point it termi-

nates. There are on each side a pair of simple branchiæ that are without the reflected pouches of *Pecten*, nearly of equal depth, closely and conspicuously striated on both surfaces; they extend anteriorly to the palpi, but posteriorly only reach a little above the ventral range; with them are connected around the mouth, by plain labial cords, two pair of subtriangular, moderately long and large palpi, each plate being hung separately to the body, as in the ordinary Bivalves; they are smooth on the outer surfaces, and well pectinated within; the plates of each pair lie one on the other, but not being attached laterally, they do not double as a book shuts, or like those organs in *Pecten*. The body has not the rudiment of a foot; the animal is, I believe, deprived of all locomotion; when the shell is not free, it is fixed by the under, which is the convex, valve.

This species, when it inhabits the crevices of rocks, is subject to great distortion; but the animal, though the shell forms a cylinder, or a right angle, or a disk, flatter than that of a *Placuna*, adapts itself to these irregularities. There is but one British species, exhibiting infinite varieties, the effect of habitat and cultivation.

The stomach contains the attritor or tricuspid appendage, that is worked by a short, grooved, elastic stylet, which, as there is no foot, has a resting-place in the upper part of the body. The intestine pierces the body to its fundus, then ascends, passing the heart without contact, which is one of the exceptions to the almost universal position of that organ in the Acephala; it then issues at the upper part of the dorsal slope, from which point it coasts in view, and is glued to the great adductor, terminating in a short, floating rectum nearly at the ventral level. The ovary appears to be amalgamated with the body, and from April to July is continually discharging the ova into the branchiæ, where they remain until they are ready to be replaced by another batch, and so on, until all are committed to their natural habitat; then the animal recovers its exhaustion, and is edible about the middle of August, but is not considered fat and in full flavour until September.

MYTILIDÆ.

We comprise in this family the genera *Mytilus, Modiola, Crenella, Pinna,* and *Avicula.* In coming to this arrangement we have had difficulties to contend with. At one time we were inclined, in consequence of M. Deshayes' remarks, to include *Modiola* and *Crenella* in *Mytilus*; but having very lately examined species of the three genera, we are by no means satisfied of the propriety of such a procedure. We think, from the configuration of the branchial laminæ and the partly closed mantle in *Crenella,* it must stand as a genus. With respect to *Modiola,* our accounts of two of its species show that there are in them considerable variations: this circumstance, with the pinnated character of the mantle in *Mytilus* and the differences of the branchial and anal mantellar terminations of the two genera, have made us hesitate to merge *Modiola* in *Mytilus.* The variations in the two do not perhaps amount to generic ones, and a coalition may eventually take place. We have no difficulty in placing *Pinna* with the *Mytili*; its animal in almost all points, particularly in the shape and position of the adductor muscles and internal nacreous aspect of the shells of the two genera, appears to support this determination. With *Avicula* we have greater hesitation; but the recorded accounts by Poli, of the animals of that genus and *Pinna,* show such a similitude as to constitute a *primâ facie* case for depositing them with the *Mytilidæ.* With these views, the family of the *Aviculadæ* may be dispensed with. This location of *Avicula* must not be considered as settled, even with reference to our method, for it is not improbable that it may have considerable alliance with the *Ostreadæ*; but it is really immaterial as regards natural order whether it ranges with the *Mytili* or *Ostreæ,* or constitutes an independent family, for in that case it must be fixed between the *Mytilidæ* and *Ostreadæ.*

We would recommend to naturalists a strict re-examination

of this family. We may have opportunities of again observing *Mytilus, Modiola,* and *Crenella,* but the animals of *Pinna* and *Avicula* are not met with on the South Devon coasts in my district of Exmouth; I should therefore be extremely obliged to malacologists who have opportunities of seeing these animals to communicate their remarks. I shall at present give a short account of them from Poli, which I translate from M. Deshayes' extracts from that eminent zoologist, in the last edition of Lamarck's 'Animaux sans Vertèbres,' to enable naturalists to compare and weigh well their relations with each other, and with the families of the *Mytilidæ* and *Ostreadæ.*

MYTILUS, Linnæus.

M. EDULIS, Linnæus.

M. edulis, Brit. Moll. ii. p. 170, pl. 48. f. 1–4, and (animal) pl. Q. f. 5.
M. incurvatus, M. pellucidus, M. subsaxatilis, Auct.

Animal elongated, thick, subconical; at this season, 5th August, the general colour varies from white to all the hues of orange-yellow, except the foot, and the dorsal and ventral, posterior and anterior extremities of the mantle, which permanently exhibit the various shades of a deep reddish brown. The mantle is open from the very large, short, oblong oval, white, simple membranous tube, situated on the upper posterior slope, which serves for anal purposes, and a separate branchial communication by a transverse fissure in the internal septum into the ventral cavity, which, though it communicates with the same common tubular process as the rectum, has no further connexion with the anal conduit. The mantle has a double margin, a plain outer and an inner one, which, from the point of the siphonal tube to the centre of the ventral range, is furnished with tentacular dendroid cirrhi, 15–25, of a pale brown on the main stems, with the ramose subfoliated fimbriæ shadowing to pale yellowish white; the remainder of the ventral range, in which the byssus and foot act, is only broken into long white dentations; the two

margins are connected by short close-set perpendicular muscular threads, which act not only by the lines of junction, but also by a general subcircular contraction and dilatation of the fibres of connexion into a still closer or more lax union; the effect of this combined action is to throw out and withdraw the tentacular fringes of the posterior lateral and ventral portions of the mantle; these vertical muscular lines also supply the adherence of the mantle to the margins of the shell, as in this species there are no longitudinal muscular bands emanating from the adductor muscles to support it.

The foot is thick, fleshy, narrow, moderately long, proceeding straight from the heel, of an almost black-brown, marked with occasional lateral white lines; it produces coarse light brown byssal filaments from a groove at the posterior under part which is continued to the point; the upper surface is plain, not grooved. The animal can detach itself from the byssus, by extracting and leaving it fixed to the substance on which it is moored, and in a very short time it is replaced by another; this is the operation with the free *Mytili*. It is almost needless to remark that the great mass of these animals are closely impacted in the sublittoral and laminarian districts.

There are a pair of light brown branchiæ, of similar form, depth, and position, which run the length of the dorsal range, passing their diminished and well-fixed posterior ends into the branchial aperture; they are scarcely visibly pectinated on either side; they also anteally diminish in depth, curving to the pair of palpi on each side the mouth; they are connected by narrow labia, and at the basis with the palpi, which are long, very thick, triangular, pointed, of the same colour as the branchiæ, each having in the centre a raised line, probably an artery or branchial vein, from which they bevel on each side to a sharp edge, each pair folded together, being well striated within, not "partially," as is stated in the 'British Mollusca' on my authority, and plain on the outer surface. The liver is pale yellowish green, and granular. The crystalline stylet and stomachal attritor are present. The lateral dorsal secreting glands, which I believe produce the cartilage and a portion

of the ligament, are well developed and of very dark colour. The body is the least I ever saw in so large a shell; this is occasioned by the ovarium not being mixed up with it, but that organ is spread in great thickness over the major part of the inside of the mantle on both sides, and at the date above noted contains many hundred thousand ova, which at the latter part of the autumn are discharged into the sea, leaving the mantle a white thin membrane, after which the body of the animal increases in bulk and grows fat, becomes edible and in season, which is two months later than the oysters, as they are not considered good until the end of October.

They are much eaten at Exmouth by the working people, but in some constitutions they have either a deleterious or the opposite quality, a pruriginous effect.

It is a mistake that the ova are received in any part of the branchiæ for protection and maturation for some time previous to ejection, as not one-tenth of the immense masses of the ovarian membranes could be located there; the branchiæ, from their smoothness, are very ill adapted for such an asylum, and if they are ever seen there, it is from the unavoidable contact of the ova when in progress of exclusion: the pulli are never seen in the animal in a testaceous state, as in the fresh-water *Unionidæ*, but are at once cast to the waves, where they become the prey of various animals; still, enough escape destruction to maintain their enormous numbers. The sea in autumn is filled with the ova: at ten miles from land in 14 fathoms water, if the fishermen's lobster-pots are left for two or three days, they will be covered with very young testaceous muscles, and in a week or two more than half an inch long; but the parents never inhabit more than half a mile from the shore; of course the ova are floated out to sea, and sink as soon as they become testaceous. That the animal never carries testaceous pulli is manifest from its being more or less at all seasons edible. Though this is one of the commonest of the bivalves, it is an object of great interest to the malacologist from its elaborate organization. I may state that this is amongst the very few marine Acephala which have the ovaria attached more or less to both sides of the mantle; by

which it establishes a connection with the *Anomiadæ*, and perhaps in part with the *Terebratulidæ*. I am not sure that any other except *Anomia* is in the same category, and in that genus the ovary is only glued to the area of the mantle, which rests on the lower valve.

MODIOLA, Lamarck.

M. BARBATA, Linnæus et Auct.

M. barbata, Brit. Moll. ii. p. 190, pl. 44. f. 4.
M. Gibbsii, Auct.

Animal elongated, thick; mantle open, double-edged, with red-brown simple margins. The body is large, subrotund, brown; from it springs a byssal foot, having a large fissure at its hinder part, from whence a fine bushy dark byssus issues; the anterior part is finger-shaped, white, not long or pointed, with a longitudinal central depression. On each side the body are a pair of narrow branchial laminæ, the upper not half the depth of the lower; they are coarsely pectinated, and entirely coast the body, being brought close to the posterior extremity to receive the water. This structure of the branchiæ is the substitute for the absence of tubes or any sort of siphonal fold of the mantle. The palpi are red-brown, long, flat, strongly striated transversely within, smooth on the outer surface.

The shell of the present animal was 2½ inches transverse measure; it was taken in the dredge in 15 fathoms water in a six-mile offing at Exmouth; they are rare in that locality.

M. TULIPA, Lamarck.

M. tulipa, Brit. Moll. ii. p. 187, pl. 45. f. 7, and pl. 48. f. 6; and (animal) pl. Q. f. 6.

Animal elongated, body thick, pale red; mantle open, margin simple, plain, forming two very short, of the same length, scarcely separated pale yellow siphons, each fringed with about 20 close-set short cirrhi. Foot long, flattish, slender, with an intensely flake-white longitudinal line in the centre, having a byssal groove, increasing in depth from point to heel, from which, on its posterior side, a fasciculus of strong

filaments issues, by which the animal, wherever it may be placed, immediately attaches itself, and however frequently removed, refixes itself in a few minutes. On each side there are a pair of pale brown branchiæ, narrow, linear, coarsely pectinated, but less on the inner than on the outer surface; the palpi are short, pointed, triangular, and usually lie rolled together laterally; they are of the same colour as the branchiæ, smooth within and strongly striated externally.

This very elegant species is frequently taken alive in the coralline zone at Exmouth. It differs very materially in the organs from its congener *M. barbata*.

M. MODIOLUS, Linnæus.

M. modiolus, Brit. Moll. ii. p. 182, pl. 44. f. 1, 2.
M. phaseolina, Brit. Moll. ii. p. 186, pl. 44. f. 3, juv.
M. Ballii, Brown.
———, Brit. Moll. ii. p. 192.

The *M. modiolus* and its young shell, styled by some *M. phaseolina*, are seldom met with on the South Devon coasts. The *M. Ballii* is of very doubtful British parentage; we can refer to no figure; and the animals of the first two have escaped our researches.

CRENELLA, Brown.

C. MARMORATA, Forbes.

C. marmorata, Brit. Moll. ii. p. 198, pl. 45. f. 4.

Animal suboval, thick, pale yellow; mantle closed on the anterior ventral half, at which point is a large aperture for the foot; the margin of the opening is plain, it is then closed, and forms a mixed purplish-red and flake-white membrane, which is produced into a small cylindrical anal tube, grooved at the base, with four or five minute dark cirrhi at the termination; and on its sides the mantle forms two pendulous puckered flaps of the same colour as the tube, with which the animal by bringing their margins into contact produces a canal, in conjunction with the groove, to convey the water to the branchiæ. The foot is white, with a deep byssal groove, from which a strong

filamentary mass issues, and fixes the animal to *Ascidiæ* and marine substances. The anterior part of the foot is white, narrow, finger-shaped, and moderately pointed; when in full extension it takes the form of a narrow, flat tape, marked with a slight brown line running from base to point; it is protruded close to the anterior side of the byssus, but as an organ of locomotion it only comes into action when the animal is detached from its mooring, which it has the power of effecting by withdrawing the end of the byssal lamina from the groove in the heel, and it can refix itself by spinning a new byssus; —this operation we have frequently seen;—when fixed, the foot appears to be an organ of tact, as it is often exserted, and the point kept in movement as if searching or feeling. There are a pair of branchial laminæ on each side of the same size, and smooth on all surfaces; the palpi are long, subtriangular, pale brown, and pectinated. The animal differs from *Mytilus* and *Modiola* in the perfect symmetry of the four branchial plates.

This species is often attached to old bivalves and masses of *Serpulæ*, but is more usually imbedded in the coriaceous mantle of the *Ascidia mentula*, from which twenty of all sizes have been extracted. It inhabits plentifully the coralline districts at Exmouth.

We have not seen alive the following species:—

C. NIGRA, Gray.

C. nigra, Brit. Moll. ii. p. 202, pl. 44. f. 5, and (animal) pl. Q. f. 7.

C. DECUSSATA, Montagu.

C. decussata, Brit. Moll. ii. p. 210, pl. 45. f. 2.

C. RHOMBEA, Berkeley.

C. rhombea, Brit. Moll. ii. p. 208, pl. 45. f. 3.

C. DISCORS, Linnæus.

C. discors, Brit. Moll. ii. p. 195, pl. 45. f. 5, 6, pl. 48. f. 5.

C. COSTULATA, Risso.

C. costulata, Brit. Moll. ii. p. 205, pl. 45. f. 1.

C. FABA, Müller.

C. faba, Brit. Moll. iv. Appendix, p. 256.

Of the above, *C. costulata* is a variety of *C. discors*, though admitted by authors as a species. The *C. faba*, taken from a

duck's stomach, shot in Northumberland, *sub fide Kingii*, is considered by him of doubtful British origin. We have the specimen.

PINNA, Linnæus.

P. PECTINATA, Ibid.

P. pectinata, Brit. Moll. ii. p. 255, pl. 43. f. 1, 2, and pl. 53. f. 8.
P. ingens and *P. papyracea*, Auct.

Animal elongated, body large; mantle open, of delicate texture except at the margin, which is furnished at the posterior end with two rows of tentacular cirrhi, but only one at its anterior portion. There are on each side a pair of large branchiæ of nearly equal size and crescent-shaped, united by two wide labia, foliaceous on the internal surface, which fall on each side the body, connected with the buccal orifice and a pair of short, narrow, lanceolate palpi, which appear disproportionate for so large an animal. The mantle forms neither siphons nor even sessile orifices. The foot is conically subcylindrical, not long, with a byssal groove at the posterior bend, from which a large fine silky byssus of attachment issues; this the animal has the power to discard when it wishes to change place, and can refix itself by spinning in a very short time a new one.

Having only seen very young examples alive, we have for descriptive assistance had recourse to M. Poli, 'Test. Sicil.'

AVICULA, Lamarck.

A. TARENTINA, Ibid.

A. tarentina, Brit. Moll. ii. p. 251, pl. 42. f. 1, 2, 3, and (animal) pl. S. f. 4.

Animal suboval compressed; mantle entirely open, having the margin fringed, as in *Pinna*, with tentacular filaments; there are no siphons nor orifices. The dorsal range of the shell usually forms a slender linear posterior elongation, which is lined by a fold of the mantle. On each side of the body there are a pair of nearly similar-formed branchiæ of crescent shape,

which around the mouth are united by two foliaceous labia, accompanied on each side by a pair of short palpi that on their free margins are obliquely truncate. The body is diminutive in proportion to the size of the shell. The foot is small, subcylindrically conical, grooved at the posterior part, and emits a coarse byssus, which has all the active incidents of that of *P. pectinata*. We have been assisted in this account by extracts from Poli's 'Test. Sicil.'

It appears then that *Avicula* scarcely differs from *Pinna*. We think that on comparison of the two genera, malacologists will be inclined to consider that their natural position is with the *Mytilidæ*.

It may be in my power to supply a fresh description of *Pinna*, but extraneous aid will be required for *Avicula*, which has not occurred to us at Exmouth, though it has been frequently captured by the trawlers on the Plymouth ground.

ARCADÆ.

The *Arcadæ* form a family of five genera, four of which, *Arca*, *Pectunculus*, *Nucula*, and *Leda*, are so well characterized by animal distinctions, as not to require further remark; we add a fifth, *Galeomma*, which, though an aberrant genus, we think we shall satisfactorily show has close relations with this family, wherein it is placed until the animal receives additional elucidation; but this, from its rarity, may be far distant. It is to be regretted that near twenty years ago, when we had it alive for some days, we did not make better use of our opportunities. Several observers have seen it, but, it appears, not with perfectly satisfactory results. Naturalists are earnestly invited to look after this elegant animal, and not fail to note at least its external organs and habitudes. Notwithstanding the uncertainty attached to this genus, we think its provisional residence in this family will become a permanent one; — at all events, almost any position will be more satisfactory than its present association with the *Kelliadæ*.

The family of the *Arcadæ* is the first, according to our method, in which the adductor muscles are established in their pyriform shape, similar size, and lateral position: the departure from the muscular disposition of the *Ostreadæ*, to the lateral one of the great mass of the bivalves, commenced in *Mytilus*, and has become complete in this family.

Since the above was written we have added to this family a sixth genus, *Lepton*, under which head our reasons for this procedure will be found.

ARCA, Linnæus.

A. TETRAGONA, Poli et Auct.

A. tetragona, Brit. Moll. ii. p. 234, pl. 45. f. 9, 10; (animal) pl. P. f. 1.

Animal elongated, thick, white; mantle open throughout the ventral range; its edge is plain, but the upper part of the posterior margin is marked, as in the *Pectunculi* and *Pectines*, with about 40 close-set, equidistant dark dots or ocelli, which become obsolete and vanish anteriorly; the margin, or area within the ocelli, is mottled with pale yellow flake markings, which are also seen, though more faintly, on the under surface. The foot is white, and when at rest is bent, but, exserted, tapers subconically. There is a deep byssal groove at the posterior geniculated portion, for the green filamentous mass, which at the point of insertion into the cavity is split into two laminæ; a neighbouring gland appears to supply a green glutinous fluid, from which the filaments are formed; we conclude so, as whenever the byssus was extracted, the animal immediately produced from the fissure a flow of matter which almost instantly resolved itself into byssal threads; and it is quite certain it can free itself from a state of fixity, which is effected by drawing the byssus from the groove, and entirely deserting it. This manœuvre we have also seen performed by the animals of *Arca lactea* and *Galeomma Turtoni*. There is little doubt that all byssus-bearing mollusca, when not confined in stony cavities, have the power of a limited locomotion by abandoning their moorings.

The foot, independent of the deep fissure at the base for the

insertion of the byssal lamina, has a shallower continuation of it to the point. We have only seen the foot when protruded in a linguiform or subcylindrical shape, but it is probable that the longitudinal groove can expand and assume a spatulate character like that of *Nucula* and *Pectunculus*; but the animal is very sensitive, and during a long examination never showed any kind of locomotion. There are on each side a pair of brown branchial laminæ of nearly similar size, of small depth, which run quite horizontally; they are slightly crenated at the edges, and the outer surfaces are less striated than the inner. There are no pendulous palpi, but the linear branchiæ are continued in a narrowed form on the buccal area, and meeting with their fellows, constitute expanded labia instead of strict palpi.

Without entering into much anatomical detail, we may observe that the organs which supply the motive power to the circulation have a different arrangement in those *Arcæ* which have the beaks widely separate; in them, there are on the medial line of the dorsal range two ventricles, each accompanied by an auricle, instead of, as in the ordinary arrangement, a single ventricle with an auricle, on each side: but this deviation does not extend to all the genera of the *Arcadæ*; it appears to be the result of the distance of the branchial vein, on each side, from the motive power. In *Pectunculus*, in which the beaks are close together, and the points where the branchial veins pour the blood into the auricles are little separated, the ordinary structure of the single ventricle prevails.

This species is very rare, but it has been taken by us more than once alive, in the coralline zone at Exmouth, in the sinuosities of masses of *Serpulæ* that are deposited in old bivalves.

A. LACTEA, Linnæus.

A. lactea, Brit. Moll. ii. p. 238, pl. 46. f. 1, 2, 3.

Animal oblong, thick, body white; mantle pale red towards the middle of the dorsal range, entirely open, having the under surface of the ventral line marked with irregular flake-brown blotches on a pale yellow ground, and the upper, for some

little depth, with a sand-like rusty-brown belt, and a darker interrupted line nearer the margin, which is finely dentated; but there are no equidistant points or ocelli, as in the last species. The mantle is without siphonal folds. The foot is white with a deep fissure at the bend, and is provided with a green filamentous membrane for attachment, which has all the same incidents as in *Arca tetragona*. The foot is pure white, and can be exserted to a considerable length; it is fleshy, tapers cylindrically, and is very like that of *Galeomma*. There are on each side a pair of similar-sized, very thin, pale yellow symmetrical branchiæ, which gradually taper and unite around the mouth, forming a double lamina, of the same character as in *Arca tetragona* and *Pectunculus glycimeris*.

This species is frequently taken free in the dredge, in the coralline zone at Exmouth, and also fixed by the byssus amongst the masses of *Serpulæ* in old bivalves.

We had in our possession the identical *Arca barbata* first introduced as British by Dr. Turton in his 'Conchylia Dithyra,' and, on showing it to Dr. Goodall, he expressed an opinion that it was an exotic specimen.

We have not seen alive the

A. RARIDENTATA, Searles Wood.

A. raridentata, Brit. Moll. ii. p. 241, pl. 45. f. 8.

PECTUNCULUS, Lamarck.

P. GLYCIMERIS, Linnæus et Auct.

P. glycimeris, Brit. Moll. ii. p. 245, pl. 46. f. 4, 5, 6, 7; and (animal) pl. P. f. 6.

Animal suborbicular, lentiform, bluish white; mantle open throughout the periphery of the shell, except the dorsal line; the margin is plain, having its upper surface for the depth of an eighth of an inch powdered with minute sand-like, pale red, brown or black points. There are at the posterior side, for half its length, at the verge of the mantle, about twenty-five minute equidistant black dots or ocelli, besides short, brown, transverse bars; the under surface is marked with short flake-white cross-lines. The mantle has neither tubes nor

orifices, but under the posterior termination of the branchiæ there is a very short anal duct issuing from the body, with a small round reflexed margin.

The foot in the live animal is snow-white, without a byssal gland and groove, but deeply cloven in the longitudinal line of its base to effect a subdiscoidal extension; it springs from the centre of the basal portion of the body; when in full action it ranges anteally and posteally, forming an elongated suboval disk at the central portion, and tapers at each end to a moderately pointed termination; when the foot is not fully protruded, it forms three or four folds at the margins; the animal does not execute a direct progressive locomotion, but only turns the shell round on its disk, or from side to side. There are on each side a pair of symmetrical branchiæ of the same size, which, instead of having the transverse striæ or circulatory vessels linear, present the appearance of white wavy ringlets, and are crossed by other sinuous lines; both surfaces have much the same depth of markings. The branchial laminæ hang very obliquely, and from the smaller or anterior extremity a pair of very narrow, light brown, linear labia or palpi, smooth on both sides, originate, and pursue their course around the mouth, and meet with the fellow pair. In their linear form and drooping position, these appendages much resemble the labia or palpi of *Nucula*.

This species is frequently taken alive in the dredge in the coralline zone at Exmouth. We observe a close alliance between *Pectunculus* and *Nucula*; both have the same sort of suboval foot disk, and a similar quality of progression; and the linear connecting branchial palpi greatly resemble each other.

NUCULA, Lamarck.

N. NUCLEUS, Linnæus.

N. nucleus, Brit. Moll. ii. p. 215, pl. 47. f. 7, 8; (animal) pl. P. f. 4.
N. decussata, Brit. Moll. ii. p. 221, pl. 47. f. 1, 2, 3.
N. radiata, Brit. Moll. ii. p. 220, pl. 47. f. 4, 5, and pl. 48. f. 7.

Animal suboval, thick, having the ventral portion of the body mottled flake-white; the liver is dark green, with the

snow-white ovarium attached to it, full of ova in July. The mantle is open from the anus to the buccal aperture, its margins plain; there are no tubes, not even an orifice, but the rectum terminates within it by a simple perforation in the body. There are two branchial laminæ on each side, brown, of an elongated triangular form, and fixed horizontally; the broader part of them is at the short truncate or anterior end of the shell, from whence they gradually taper to the posterior termination, close to the debouchure of the rectum; the upper lamina,—which is contrary to the usual plan of those organs in most of the Acephala,—is by far the largest, and entirely envelopes the under one of similar shape; they are finely striated on the outer surface, but more visibly on the inner. There are two labia or pendulous appendages on each side; the one nearest to the anterior end of the branchiæ hangs vertically, the upper part of it being of a white, elastic, coriaceous substance as far as the middle, when it changes into a transversely striated brown narrow leaf-like lamina, the half of which is longitudinally doubled on the other portion; the second labium, or that nearest to the buccal orifice, coalesces with its counterpart on the other side, encircling the mouth, and then accompanies the other, on the same side, in a pendulous direction to the ventral region; it is long, linear, coarsely transversely striated as its fellow, and has also the one half folded on the other. This is a very singular structure of these organs, but the foot exhibits a still greater departure from the ordinary forms of that organ; it is pale yellow, of a regular oval form, deeply serrated at the margin into about fifty denticular points; one-half the disk when within the shell lies folded on the other, but when in action it becomes a flat subcircular disk; the motion of the animal, though progressive, is not direct; it turns round as on a pivot, and its path describes an irregular ellipse. The animal is shy, and requires continual attention to observe these manœuvres.

This species is extremely common alive in the Exmouth coralline region.

Conchologists have exercised their ingenuity in converting some very trifling varieties into distinct species. The

N. radiata of authors is beyond doubt the "*nucleus*," and so is the *N. decussata*. We have examined the animals of the three, and they are absolutely identical. The Exmouth variety of the "*nucleus*," termed "*decussata*," does not attain so large a size as the Irish examples, but I challenge the most acute observer to point out an essential conchological variation except the one stated.

N. NITIDA, Sowerby et Auct.

N. nitida, Brit. Moll. ii. p. 218, pl. 47. f. 9.

The organs of this species are similar in essentials to those of the *N. nucleus*. We may state, the specific distinctions are, that the foot is of much paler colour, and the disk less deeply dentated; the branchiæ are paler and smoother on the outer surface, but more striated on the inner, than in the *N. nucleus*. It inhabits in company with its congener, but is twenty times more rare.

N. TENUIS, Montagu.

N. tenuis, Brit. Moll. ii. p. 223, pl. 47. f. 6; (animal) pl. P. f. 5.

We have not seen it alive; it is a Scotch production.

LEDA, Schumacher.

L. CAUDATA, Donovan et Auct.

L. caudata, Brit. Moll. ii. p. 226, pl. 47. f. 11, 12, 13; (animal) pl. P. f. 2.
Arca minuta, Auctorum.

We can say little of this genus except that it appears to differ from *Nucula* in having the mantle produced into two siphons of moderate length, partly united, but bifurcating at their terminations. We have only rarely taken the dead shells of this species at Exmouth. It is an abundant Scotch production, and differs much in the outline and markings.

L. PYGMÆA, Münster.

L. pygmæa, Brit. Moll. ii. p. 230, pl. 47. f. 10; (animal) pl. P. f. 3.

This species, if distinct from the *L. caudata*, is unknown to

us; we believe it has only occurred in the Hebrides. We doubt the distinction.

GALEOMMA AND LEPTON, Turton.

The genera *Galeomma* and *Lepton* have received from the hands of Dr. Turton a conchological constitution, but as respects natural position, they have been buffeted from place to place, in accordance with the various views of naturalists. In some systems they are associated with the *Kelliadæ*, though doubtfully, on account of the want of knowledge of the animal. These disturbing causes are happily in a great measure removed, and we have it in our power to fix permanently these wanderers in the only British family that has with them a sufficiently corresponding community of attributes. Though they are aberrant genera of the Arcadan type, when strictly considered they undoubtedly belong to that family, and it will be shown that they have the strongest claims to this their natural lineage.

To establish a new family for these beautiful genera would indeed be a superfluous labour, and repugnant to our well-known feelings to add unnecessarily to a host of worthless positions, when there is already an unmistakeable resting-point. But our descriptive notes will further explain these matters.

GALEOMMA, Turton.

G. TURTONI, Sowerby.

G. Turtoni, Brit. Moll. ii. p. 105, pl. 36. f. 11; (animal) pl. O. f. 5.

Animal oval, fleshy, pure white; mantle of thin texture, except at the edge, which is muscular, and forms a tumid cord that extends beyond the shell, from which are thrown off undulated double margins, one of which lines the shell, and is marked with equidistant frosted-white eminences or ocelli, eight or nine on each side, with fine white filaments between them. The mantle is partly closed in front, but there is an anterior pedal aperture. The foot is long, cylindrically tapering to its termination; at the heel, close to the body, is the

byssal fissure, from which a fasciculus of fine filaments issues, which fix the animal so firmly to whatever it is placed on, as to require some force to detach it; in fact, the byssus is discarded by being altogether withdrawn from the slit in the foot whenever an attempt is made to remove the animal by force; but though we repeated this operation several times, the little creature did not appear to be injured or less lively, but as soon as it had crawled to some distance, we had the good fortune to witness the formation of a new byssus, which was effected by the discharge of a light green glutinous opake matter from the fissure at the heel of the foot, which by its ponderosity resolved itself into delicate fibrous filaments that instantly adhered to the saucer: we detached the animal several times, the byssus was always left, and a new one formed. On leaving it for the night, in a marked position, we found in the morning that it had detached itself by abandoning the byssus, and formed another at a considerable distance.

The animal marches with great vivacity, by flattening the valves into the form of a circular disk; it then, by the foot, aided by the muscular margins of the mantle, makes rapid progression. We are unable to speak of the branchiæ, or the particular character of the palpi or labia, and whether they are distinct free pendulous palpi, or the drooping folded labia of the *Nuculæ*; nor is it clear, from M. Mittré's or Dr. Philippi's account, which of the two forms is the true one. I blame myself greatly for my inattention to these points when I had it in my power to verify them; they have now become important, either to support or impugn my reasons for placing *Galeomma* in the family of the *Arcadæ*. But if even the palpi or labia should show a difference from the usual structure of those organs in the *Arcadæ*, it must be considered as an aberration of an aberrant genus; however this may be, abundance of facts will be adduced to justify the removal of *Galeomma* to the *Arcadæ*. My memory will not allow me to say anything of the siphonal apertures, or of the long anterior stylet. We have twice taken this beautiful creature alive in the coralline zone off Budleigh Salterton, Devon.

It will be observed in the account of this animal, taken from notes made twenty years since, that the mantle is partially closed in front; this is the only point against the Arcadan position, as in the typical species that organ is open throughout the ventral range. We certainly did not then observe so critically as now; there may be an error; the animal requires further investigation, which we confidently believe will confirm our present views. *Galeomma*, by the contiguity of the beaks and very limited ligamental central facet or area, together with the minute glossy circular porcellanous nuclei of the umbones, is closely allied to *Pectunculus*,—also, perhaps, more so to *Arca*, particularly *A. tetragona*,—by the linear character of the hinge and ligament, which has the central portion semi-internal, and is carried on each side to the termination of the dorsal line, being throughout as straight as in *Arca*; the impressions of the adductor muscles scarcely differ in the two, and there is in both the same dull scabrous irregularly nodose aspect of the inside of the valves. The ventral gape in the regular specimens of *A. tetragona* is similar in *Galeomma*. The character of the striæ or minute ribs is the same as in *Arca lactea*, except that in it the bifurcations are seen internally, whilst in *Galeomma* they are external. With high powers, the oblique, though nearly obsolete teeth may be observed on the ligamental line, and the internal linear areas are similar to those in *A. tetragona* and *P. glycimeris*. Many other minute similitudes may be mentioned, but enough has been advanced to show that the conchological indices decidedly fix *Galeomma* with the *Arcadæ*.

Let us speak of the internal organs. The foot in *Galeomma* is byssal, and precisely of the same form and character as that of *A. tetragona*. As a last, but, as we think, very convincing proof of the relation of this genus to the *Arcadæ*, are the regular equidistant frosted-white eminences or ocelli, which, except in colour, entirely resemble those in the typical *Arcæ*; and as there are no other genera but the *Arcæ* and *Pecten* in which the mantle of the animal is furnished with ocelli, it follows, from the entire difference of the position of the adductor muscles in *Pecten* and *Galeomma*, that this species, on

malacological considerations, can belong to no other family than the *Arcadæ*.

LEPTON, Turton.

L. SQUAMOSUM, Montagu.

L. squamosum, Brit. Moll. ii. p. 98, pl. 36. f. 8, 9; and (animal) pl. O. f. 6.

Solen squamosus, Auct.

Animal inhabiting a very flat, subrhomboidal, white, porcellanous, punctured shell; its ground colour is a clear white. The mantle is very large, having the margins sinuated, often puckered into two or three folds at the will of the animal; they extend beyond the shell more than one-third of the vertical measure at its centre, from which springs a row, on each side the middle of the ventral range, of twenty-five rather long, slender, milk-white tentacular pointed filaments; but the mantle thus clothed is only protruded largely beyond the shell, from the middle of the anterior side, throughout the ventral range, to the same level as the posterior end; from these points to the umbones it is never seen, being either closed or not protruded, but its suture or edges are furnished with about forty long, strong, blunt, frosted-white, rather close-set cirrhi varying in length; a part of these range at the posterior side of the beaks, above the sessile anal orifice, which occupies a small space without cirrhi, between the termination of the protrusion of the margin and the commencement of the larger filaments on the broader, larger, and posterior side; of that part of the filaments at the anterior side of the beaks, one is thicker, broader at the base, and double the length of the others; this is the last of the larger ones, which at one time I thought was tubular and might be an oviduct, but further examination seemed to disprove this idea. None of the filaments show much motion; the long one only, when the animal advanced a step, made an arcuated contraction, similar to that of the fore-finger *in extenso* when quickly brought down to the palm of the hand; it then resumed the straight position to await another step: all the other cirrhi are either retractile or contractile, separately or *en masse*.

The foot is hyaline azure, with a broad longitudinal medial line of intense snow-white, and a still intenser flake at the anterior end; it is fixed to the centre of the body by a moderately long pedicle; on first protrusion it takes a vertical position, and has a linguiform tapering aspect, but this part almost immediately, after feeling about, ranges itself anteriorly and horizontally; and at the same time, on the other side of the pedicle, a bevelled, attenuated, pointed portion issues, somewhat shorter than the first; this is longitudinally cloven as far as the pedicle, and can form a sort of oval disk, but on the march it is rarely expanded: at the base of the cleft is the byssal gland, which occasionally pours out a glutinous red filamentous matter, that in confinement is copious, and discharged anteriorly, which at first I thought was fæcal matters, and was puzzled to account for such an issue anteally, but the subsequent view of the single sessile posteal anal conduit and the ejection of pellets cleared up the difficulty. This foot is in every respect similar in miniature to that of the *Pectunculus pilosus* and of the *Arcadæ*, and in no other bivalve family does the foot exhibit a similar structure: this singular pedal characteristic of itself would sufficiently confirm the natural position of *Lepton* and *Galeomma*.

The animal is vivacious, and allowed itself to be examined many times daily; it marched with quickness, but I only once saw it progressing in a vertical position; the usual posture of the shell is to rest on one of the disks, which is frequently changed for the other; the adductors did not appear to allow of a greater opening of the valves than the ordinary extent. The animal, when placed at the bottom of a glass, always crawled up and moored itself by a filament at the side; sometimes, however, it slipped its moorings and floated free on the surface of the water with the umbones downwards, and after an interval refixed itself by spinning a byssal thread.

I cannot speak at present of the branchiæ and palpi, as the animal and shell are in my collection, and are thus preserved to show that the shell, though usually described by conchologists as gaping, can, in consequence of the flexibility of the thin laminar valves, be completely closed. There is no

branchial siphon; but there are mantellar folds, which, with the great ventral opening, amply provide for the admission of the water.

The animals of this interesting group exhibit, in the tentacular filaments and curious foot, as well as in the sculpture of their shells, very considerable variation from *Kellia rubra* and *Kellia suborbicularis*,—the types of one of the genera of the family in which they have been located by authors, doubtless from the want of knowledge of the animal. Taking into consideration that the Leptons have many of the attributes of the *Arcadæ*, and especially giving due weight to the remarkable similarity between the foot of *Lepton squamosum* and the *Pectunculus pilosus*, I am almost induced to believe that it is in a false position, in connexion with the *Kelliadæ*, and that it ought to follow or precede *Galeomma*, which, with me, is an undoubted genus of the *Arcadæ*.

The punctures of this species and of *L. convexum* are in the test; with respect to its congener, the *L. nitidum*, it has been stated that it is smooth and without punctures: this is a mistake, as I can show fifty specimens not only well-marked on the greenish epidermis, but in the substance of the shell.

I have the satisfaction to state, that I have observed another live *L. squamosum*, and also obtained full notes of the animal of one of our great desiderata, the *L. nitidum*, from a most lively animal, which for several days gave me every facility for examination. The *L. squamosum*, just alluded to, was kept thirty-four days in a glass of sea-water, changed daily, and was apparently as vigorous as when first placed in captivity; it thus appears that the Conchifera can exist for a long time in pure sea-water, on the animalculæ it contains, though that aliment may not be their sole resource in freedom.

I may observe, that the habitude of crawling and swimming with the foot uppermost in *Lepton*, and in several other minute bivalves, perhaps in all, shows the close alliance of the Acephala with the Gasteropoda, all of which, in their minute condition, have precisely the same peculiar system of dorsal natation. I ought to have mentioned that the liver is light green and

mixed up with a flake-white ovary; but from the extreme tenderness of the branchiæ, I cannot speak of them and the palpi with certainty as to form and number.

July, 1852.—As I had just finished the above, a lively specimen of this species was met with, which, on being placed in water, at once unfurled its long and beautiful fringes, and exserted the ample niveous mantle and foot. This is certainly the Prince of British bivalves; the snow-white colour of both animal and shell sheds over this interesting creature the inexpressible charms of purity and elegance. It now lives in the same vase with its pigmy congener, the *L. convexum*.

L. Clarkiæ (nova species), Clark.

L. Clarkiæ, Brit. Moll. iv. p. 255, pl. 132. f. 7.

L. testa fragili, obliquo-subovali, compressa, postice et antice rotundata, albida, mediocriter nitida, striis concentricis, confertis, tenuibus notata; apices minutos, prominulos, subtilissime punctatos gerente. Latus rostris anterius, quoad longitudinem transversam, duplo posterius superat. In valva dextra, utroque, dentes laterales, duplices, distantes apparent; in sinistra, simplices; inter quos, utraque valva, dens unicus, primarius, erectus, acutus, oritur.

Mensura obliqua $\frac{1}{11}$, transversa $\frac{1}{10}$, altitudo aut crassitudo $\frac{1}{40}$ unciæ.

Zonam corallinam Devoniæ meridionalis, prope ostium Iscæ, rarius habitat.

Animal ignotum.

Of this minute and elegant species, a series of eighteen perfect specimens have occurred, and having compared the hinge and dentition with forty examples of the *L. convexum* and *L. nitidum*, I can state that there is not the slightest variation in this respect in the three species. Its distinguishing characters are the almost perfect obliquely oval shape, being without a trace of the subangularity which is invariably seen at both extremities of the congeneric Leptons; and, as to the punctures, it is more devoid of them than the glabrous varieties of the *L. nitidum*, which, however, in the forty specimens I possess, all show more or less the punctured aspect on the umbonal area; but in the *L. Clarkiæ* only the apical circumscribed space is in some, but not in all examples, almost

invisibly punctured, which condition is rather more pronounced within than on the outside of the apices.

At one time I almost thought that the *L. nitidum* and *L. convexum* might march together as a single species, subject to many varieties; but an increase of my series of both has, at least for the present, made me doubt the propriety of considering the two as identical. The animal of the *L. convexum* is still unknown, and until it occurs, a safe determination on these points cannot be made. The animal of the *L. nitidum* I know well, having in the last summer observed two examples for four days; it only differs in some minor peculiarities from the *L. squamosum*, one of which I kept in sea-water thirty-four days, when it was killed whilst still vigorous, in consequence of my departure from the sea-side.

I may state, that in *L. Clarkiæ* the concentric striæ of increment are close-set and sharp, and sometimes broken into very short waved streaks; these in some of the specimens are crossed by gently raised lines of an intenser snowy-white than the general colour, which radiate sparingly from the beaks to the basal margin.

This delicate species cannot be confounded with any of the minuter bivalves: by its hinge it is essentially a *Lepton*: the nearest approach to any other species is to the *Montacuta bidentata*, which differs in form, colour, and fragility, and in having the lateral dentitions almost close together, without the primary teeth between them; instead of which, there is a minute moveable ossicle, convex on one side and concave on the other, as in the *Anatinæ* or *Thraciæ*; this locks into a sloping pit that has sometimes the appearance of being ridged, which is only due to portions of the ruptured ossicle adhering to it; but in *Lepton* the primary teeth are persistent or integral parts of each valve. Fresh examples, new facts, and further investigation have all but convinced me that *L. convexum* and *L. nitidum* are distinct. Our Leptons, which I name according to rarity, will stand thus: 1st, *L. convexum*; 2nd, *L. Clarkiæ*; 3rd, *L. nitidum*; 4th, *L. squamosum*.

One of the distinguishing marks of the new species has been already alluded to,—the oblique rounded outline; but another

equally important is, that the side anterior to the beaks is double the transverse length of the posterior one; whereas in all the other Leptons, of which I have more than a hundred examples, the beaks are nearly central, and they have more or less subangularity at the sides; therefore the oblique outline, rounded sides, and position of the beaks, are unerring guides to distinguish the *L. Clarkiæ* from its congeners.

The animal has not been observed.

L. CONVEXUM, Alder.

L. convexum, Brit. Moll. ii. p. 102, and iv. p. 255, pl. 36. f. 10, magnified.
L. nitidum, Turton et Auct.
Kellia nitida, Brit. Moll. ii. p. 92, pl. 36. f. 3, 4.

The animal inhabits a light greenish-yellow or pure white, subrhomboidal, moderately convex, more or less punctured shell. The mantle is frosted-white with the margins plain, but as much proportionately protruded beyond the edge of the shell as in *L. squamosum*; it is in like manner clothed with cirrhal filaments of about the same length, and of pruinose white, but unlike that species, they are rather less developed dorsally than ventrally; each filament at its terminal edge is studded with four or five white points or cilia, so sharp and minute as to require a powerful lens to see them. There is no conspicuous leading process, as in the preceding species, but the mantle, at the same anterior point, forms a visible projection or fold. In this species, and contrary to *L. squamosum*, the longer and broader end is anterior, but the beaks are so central, that there is little difference in the sides; the single sessile anal tube is exactly as in the last species; there is no branchial siphon,—the water enters at the extensive ventral aperture. The foot is almost in every respect similar to that of its congener; it is perhaps larger in proportion, of pale azure hue, marked with intense but irregular flake-white minute blotches; the posterior extremity is as long as the portion anterior to the pedicle; its termination is perfectly aciculate, and like its congener deeply grooved as far as the junction with the body, at which point is the byssal gland,

and the superabundant filamentous matter is similarly discharged.

The *L. squamosum* is a lively creature, but this, not one-third of the size, is far more active, creeping up a glass as easily as a Gasteropod; but the posterior portion of the foot is not expanded; perhaps in freedom it is deployed on the march; in confinement both shell and foot are carried laterally. The liver is light green, united to a flake-white ovarium, now, in June, full of ova. Transverse length $\frac{1}{8}$, vertical $\frac{1}{12}$, diameter $\frac{1}{13}$ of an inch. It would appear that this species in every essential is identical with the *L. squamosum*, and it settles the position of the yet undiscovered *L. convexum*. This is the first record of this rare animal that has appeared.

Exmouth, June 20, 1852.

I have this day the pleasure to state, that the problem is solved as to the identity or distinctness of the *Lepton nitidum* and *L. convexum* by the capture of a live specimen of the latter, having the shell sculptured with the rough and intensely marked characteristic punctures of that species. On putting the animal into water it instantly deployed its organs; and for their description I have only to refer to the preceding account of the *L. nitidum*, which in future will take the appellation of a variety of its old associate. The two are so identical, that after ten days' examination I can make no alteration in the minutes, except the having seen the animal march on the disk of the foot, more than once, with the shell in a vertical position; it has all the same habitudes as the *L. squamosum*, and of course differs in no respect from its smoother variety, the late *L. nitidum*. It is now alive, and probably by changing the water daily it will live as long or longer than the *L. squamosum* mentioned above. It is therefore evident that the punctures of this species are very variable, ranging from the most minute granules that scarcely interrupt its smoothness to the coarsest sculpture.

As the specific appellation of *nitidum* is obviously improper, the more significant one of *convexum* ought now to be adopted.

Since the above was written I have taken two examples, one this morning (July 18), of the smoothest variety of the '*con-*

vexum,' late the *'nitidum'*; both are in the vase with the highly-punctured one captured 20th June last, now quite vigorous, in company with the *L. squamosum* alluded to as taken 2nd July; this capture has given me the advantage of a live examination of the two completely opposite conditions of the *'convexum,'* whereas the one above was only referable in comparison with an account of a live *'nitidum'* taken last year. And I can again state that the two varieties are identical.

I give another proof of identity. I have just (1852) taken alive a curious example, that shows one half of each valve finely punctured and the other grossly granular.

LUCINIDÆ.

This family has only one genus, *Lucina,* which includes about eight species. Live specimens of the typical *L. borealis* are of rare occurrence; we have met with none for forty years on the Devon coast, and of the *L. rotundata* only a small example has been examined. Nor have the animals of the *L. flexuosa* and *L. ferruginosa* been seen by us, but we receive them *sub fide Forbesii et Hanleyi.*

Since this was written, it will be seen below, that fortune has been favourable, and enabled us to fill up some of the gaps in the species of this family, but the curious incidents attending it are so largely noticed in the descriptive history as to dispense with further remarks.

LUCINA, Bruguière.

L. ROTUNDATA, Montagu et nobis.

Diplodonta rotundata, Brit. Moll. ii. p. 66, pl. 35. f. 6; (animal) pl. M. f. 7.

The present account of the species was written at Exmouth, in the summer of 1849, and the reason of noting the date will shortly appear.

Animal lentiform, moderately thick; mantle plain, some-

what closed anteriorly and posteriorly, leaving a large pedal opening in the centre of the ventral range; no siphonal process appears, not even an orifice; the branchiæ must be supplied through the pedal aperture. The body is very small, pale brown, with the intestine passing through the liver. There are two subquadrangular branchiæ, and two palpi, on each side; the former are finely pectinated above, and smooth on the under surface; the palpi are moderately long and pointed, as well as striated on one side; both are of a good brown colour. The foot is clear white, moderately long, flattish, and lanceolate-shaped laterally and at the point.

The *L. rotundata* has been consigned to a new genus, termed *Diplodonta*, by the learned authors of the 'British Mollusca,' on our authority as to the animal structure. I feel pleasure that they state this allocation is provisional, as the animal presents anomalies of so peculiar a nature, that malacologists are earnestly called on for a minute examination of this curious creature. I accept the invitation, and hope either to confirm my observations, or offer rectifications. This species has many of the characters of the type, *L. borealis*, and I think, whether my notes are confirmed or not, it must be considered an outlying branch of this family. The hinge and other distinctions will not, in any case, allow of the suggestion of handing over this species to the *Kelliadæ*.

Fresh, though dead shells are commonly taken in the coralline zone at Exmouth, but I never met with more than two specimens alive; the one examined was less than half an inch diameter.

The following addenda were made at Exmouth on the 22nd July, 1850, a year after the preceding notes. The account in the 'British Mollusca,' vol. ii. p. 65, of the *Diplodonta rotundata*, our *Lucina rotundata*, was made from the sketch above. The possession of a live specimen of $\frac{3}{4}$ of an inch diameter, enables me to say that my account, as far as it goes, is nearly correct; but I can offer some amplifications, particularly on that important organ the foot. Beyond all doubt, I state, that there are, on each side, a pair of branchiæ and palpi; the branchiæ are transverse, though somewhat elongated,

subangular laminæ, sinuated at the margins, pectinated, and fixed, as is usual, to the dorsal range, the upper plate being little more than half the depth of the lower one. The palpi are short, pointed, pectinated, and subtriangular; they lie on each other, and I may say, that neither of these organs present any remarkable variation from the usual run of the Acephala. The liver on the dorsal range is of an intense black-brown granular substance, with the ovary mixed up with it, more anteriorly. There are no siphons, but only a short pendulous rectum, which is a very minute cylinder, discharging by what I considered to be a crenulated slit in the mantle high up in the posterior dorsal range. If I am mistaken as to the slit, which possibly may have been an accidental lesion, in that case it would discharge within the walls of the mantle, and finally eject from the central pedal aperture, which is a large opening commencing from the posterior closure of the mantle to the anterior adductor muscle, situated very low, near the anterior ventral range, from whence the mantle becomes closed to the anterior dorsal range; therefore there are only two apertures in the mantle, the small posterior slit, for the ejection of the excessively minute fæcal pellets, and the very large ventral opening for the foot. The possession, as yet, of only one good-sized specimen has not enabled me to speak positively as to the existence of the anal fissure, but beyond doubt there is neither anal nor branchial siphon.

The foot is a most curious organ; it is characteristic of the typical *Lucinæ*. It proceeds from the centre of the body, and represents a long, lax, flat, rugose, annulated, retractile hose, with a wrinkled, elastic, clavate continuation or offspring, with slight shoulders to the terminus, which appears to be perforated; this latter, somewhat club-shaped portion, when in quietude, folds on the penultimate part, and the whole lies within the mantle. It is difficult to conceive how a flat, lax, strap-shaped, tubular pedal appendage should in action suddenly assume the appearance of an elongated, arcuated, pointed conical foot, as is represented in the figure of the 'British Mollusca,' which, however, cannot be improved as to actual appearance when the foot is exserted, except

to show a minute terminal perforation. This metamorphosis is probably effected through its elasticity, and being distended with water. In the large specimen, of which this is the description, the animal was more apathetic than the small one of the first part of these notes; the foot was never protruded, and of course no siphons, as none exist; the only movement for forty-eight hours was a central opening to admit the branchial water, and the exsertion of the margins of the mantle, which are quite plain.

We have here the decided foot of the typical *Lucinæ*, agreeably to the descriptions of M. Poli and M. Valenciennes; but if the latter is right as to there being but one branchial lamina on each side, in all the true *Lucinæ*, our present species, which beyond doubt has *two* on each side, would be an aberration from the typical *Lucina*, though so closely allied to it by the foot, which is of so singular configuration, that we think it a generic characteristic of far greater value than the single branchial plate on each side, which form prevails in all the *Anatinæ*, and in some of the *Tellinæ*. We therefore would prefer to place this animal as a *Lucina*, even if it should turn out that all the *Lucinæ* have but one branchial lamina, which fact at present is by no means to be depended on; we consider the character of the tubular foot to be more worthy and important, in this case, than that of a singularity in the structure, or rather in the disposition, of the respiratory organ; and as to the branchial plate being a single one, it is more so in appearance than in reality, which is fully explained in the notes on *Anatina phaseolina*. In this very delicate animal we could not trace the connection of the foot with the viscera of the body, if it exists. M. Valenciennes says, that the water from the foot must enter and mix with the splanchnic contents; we greatly doubt this fact, and refer for our reasons to the preliminary observations on the Lamellibranchiata.

L. BOREALIS, Linnæus.

L. borealis, Brit. Moll. ii. p. 46, pl. 35. f. 5, and (animal) pl. M. f. 6.

Exmouth, 2nd June, 1852.

This day a live specimen, about $\frac{3}{8}$ths of an inch diameter,

was met with, close in shore, at Littleham Cove. Though immediately put into water no organ was exserted, except at the centre of the ventral range a small portion of a pointed foot. As the animal continued apathetic it was opened, when a large corrugated subcylindrical foot became visible, which on being divided proved to be tubular, but near the body it appeared slightly geniculated. On each side there was one rather elongated branchial plate, apparently divided by the branchial artery in two portions; these were connected and doubled on each other, forming one thick plate, of a darkish brown colour, shot with a hue of pink, very closely and strongly decussated by the branchial vessels. No palpi were seen. The liver is brownish-green. The margins of the shell are plain, and the edges of the mantle loosely sinuated. The posterior adductor scar is pyriform, the anterior one narrow and strap-shaped. Of the two primary teeth in each valve, one of each is cloven; there is also an anterior lateral one in both valves.

Another specimen has this year (1853) occurred, of the same size, and at the same habitat. It proved lively, and has enabled me to offer some additions and explanation. The foot is very narrow but lancet-pointed, and when fully extended is nearly as long as the vertical measure of the shell; it is always in the first instance exserted from the ventral *central* point, and from thence can move itself anteally to a right angle. It is transversely and longitudinally wrinkled, and when alive has the aspect of being roughly shagreened; when dead it appears intensely corrugated across and lengthways; it has a decided heel near the junction with the body, and is beyond doubt tubular to within a short distance of the termination, and possibly may be entirely perforated. I made with the scissors two sections before the tubular structure was visible, but in so delicate an organ the pressure of the knife might close a real perforation, which I believe exists;—not to admit water either to the branchiæ or viscera, as some naturalists think, but to render the foot a potent locomotive organ by inflation, and having the power of opening and constricting the perforation for the issue and admission of the water. The

mantle is slightly dentated, and open from the anterior adductor throughout the ventral range to near the posterior muscle; it is then closed by a knotty stop, and a linear fissure is visible,—I presume, for the dejections,—and then the mantle is finally closed. Nothing is ever protruded beyond the shell except the foot. The water must reach the branchiæ from the ventral range. There is certainly on each side the mouth, a short, coarse, thick, subcylindrical, striated palpum, and I am not sure that there are not a pair on each side. The only action of the animal was the exsertion and retraction of the foot, which is well represented in the 'British Mollusca,' pl. M. f. 6.

This species is the type of the genus.

L. FLEXUOSA, Montagu.

L. flexuosa, Brit. Moll. ii. p. 54, pl. 35. f. 4.

Exmouth, 2nd June, 1852.

Animal inhabiting a white, irregularly globular shell, with a longitudinal posterior furrow. It was apathetic, and protruded no organs. On being opened, the plain-edged mantle showed only one anal fissure. In the middle of the ventral range lay a long corrugated cylindrical tubular foot, which appeared capable of great extension; it made its way through the body to the branchiæ, and there threw off vessels, right and left, which appeared to communicate with those organs, so that it would seem that the foot performs both the functions of a locomotive, and is a vehicle to convey water to the branchiæ, in lieu of the usual posterior siphon; and it is probable that throughout the genus *Lucina* the foot performs this double duty. There is only one thick branchial plate, as in *L. borealis*, doubled on itself, of a red-brown colour. No palpi were detected. The liver, formed of two minute leaf-shaped light green granular masses, curiously lines the body and part of the foot on each side.

This animal was taken in company with the *L. borealis* above described, close to the shore, at Straight Point, Littleham Cove, near Exmouth.

The undermentioned references have not occurred on the South Devon coasts.

L. SPINIFERA, Montagu.

L. spinifera, Brit. Moll. ii. p. 49, pl. 35. f. 1.

L. LEUCOMA, Turton.

L. leucoma, Brit. Moll. ii. p. 57, pl. 35. f. 2, as *L. lactea*.

L. FERRUGINOSA, Forbes.

L. ferruginosa, Brit. Moll. ii. p. 60, pl. 34. f. 1, magnified.

L. DIVARICATA, Linnæus.

L. divaricata, Brit. Moll. ii. p. 52, pl. 35. f. 3.

KELLIADÆ.

This group of minute bivalves has lately been distributed in five genera, *Kellia*, *Montacuta*, *Galeomma*, *Lepton*, and *Turtonia*, but the four latter are so generically discordant with *Kellia* (proper), the type, that we may say they have no connection with it. We have therefore, without hesitation, removed *Galeomma* and *Lepton* to the *Arcadæ*; *Montacuta*, for one of its species, to the new family of the *Montacutidæ*; and *Turtonia*, for its only species, to another new family, the *Turtoniadæ*; under which heads our reasons for these changes will be found. The lately acquired knowledge derived from an examination of all the Leptons except *L. Clarkiæ*, imperatively requires a family rectification; they have not the viviparous and tubular specialties of *Kellia*, and exhibit such other different characters and structure as fully to sanction the junction of *Lepton* with *Galeomma*, and the removal of both to the *Arcadæ*.

Again, with respect to *Montacuta*, we have relieved it of one of its late members, by consigning the *M. bidentata* to the *Anatinidæ*, as by the testaceous moveable ossicle it certainly belongs to that family, which we confidently think will obtain another recruit in *M. ferruginosa*; that is, if it should be found to have the characteristic ossicle of the tribe. The *Kelliadæ*, therefore, in our method, consists of only one genus, *Kellia* (proper), with two species.

We digress, and for the second time earnestly recommend naturalists to observe, in sea-water at least, the external organs and habitudes of the minute animals of all genera, bivalve and gasteropodan, for little more can be done from their minuteness, and publish notices of them in our natural-history records;—not mere names and habitats, as is too often the case, but their peculiarities. Opportunities of meeting with rare live animals do not often occur; we speak from forty years' experience; none ought to be passed by, and all should be examined without delay; the interval of even an hour often paralyses the animal functions: let our motto be "*carpe diem*;" many rare creatures, from its neglect, have been lost to science. The almost total dismemberment of the *Kelliadæ* is the moral of the above; we wish to impress the necessity of a more careful examination of the minuter Mollusca.

We ought to state that the true *Kelliadæ* have the hinge furnished with variable minute irregular primary teeth under the beaks, with flattish triangular laterals on each side in each valve, those of the right one being obscurely double, and a long, strong, very oblique, white internal cartilage, which is often ruptured into two parts, one of which lies in each cartilage-pit.

KELLIA, Turton.

K. SUBORBICULARIS, Montagu.

K. suborbicularis, Brit. Moll. ii. p. 87, pl. 18. f. 9 and 9 *a*, 9 *b*; and (animal) pl. O. f. 4 and 4 *a*.

Animal suborbicular, pure white; the mantle may be termed partially closed, though there are three openings in it; the ventral one is considerable, and serves for the admission of water to the branchiæ, and as an issue for a small hyaline linguiform byssal foot, which usually lies centrally exserted, to be prepared to act anteally and posteally; it is also at the anterior or shorter end, to which the beaks curve, produced into a conical entire tube, not divided within, almost as long as the shell, plain at the orifice; this anomalous production is,

as far as we know, confined to this species and *Kellia rubra*; the third orifice in the mantle is a small sessile anal one. We believe the water to aërate the branchiæ enters by the pedal fissure, and when used, is expelled therefrom; it is possible that the curious anterior tube, which is a continuation of the mantle, may, in conjunction with the central opening, also admit some water to the branchiæ; but we will observe on this point by and by.

On each side of the body there are a pair of narrow, symmetrical, pale yellow, striated laminæ, and correspondent pairs of short, thick, strong, subtriangular, coarsely striated palpi; the liver is pale green, and in close connection with the ovarium, which is a thin membranous sac full of ova in the genial season.

It is now proper to inquire into the probable uses of the anterior anomalous tube. As there is no ostensible reason why nature should have departed from her accustomed plan to place that organ before, which in every other bivalve except *K. rubra* and this is behind, we cannot rationally conceive that this singular appendage is a special branchial tube, as the pedal orifice is most ample for the entry and expulsion of the aërating fluid; we therefore think the following facts will afford malacologists assistance in determining its functions. Whilst examining some *K. suborbicularis*, my attention was suddenly attracted by observing several testaceous young ejected from the anomalous tube; these I collected and have them now by me. Notwithstanding this fact, I have never, until lately, been able to discover, in any of the numerous ovaria I have inspected, anything except ova in different stages of advancement; but it is exceedingly probable that the shells I saw ejected may have been deposited in this tubular appendage of the mantle, and there received the development in which I found them.

Since this was written, I have to state subsequent facts resulting from the examination of a very large *Kellia suborbicularis*. I placed it on the umbones, when it immediately exserted and opened the tube; by the aid of a powerful lens, I counted at its fundus fifteen largely developed ova, and I

have no doubt that this animal and that of *K. rubra* are furnished with these unusual appendages to minister as organs of reproduction. I have further to state, that on submitting the animal to my scalpel and one of Mr. Ross's microscopes, I received the fullest confirmation of my conjectures, having found in the ovarium, resting on the fundus of the tube, ova in advanced conditions, together with fully-formed testaceous young. I have carefully preserved the ovarium. Therefore this species, like *K. rubra*, is undoubtedly viviparous: the only difference between the two is, that one of the young phases of *K. rubra* is greatly matured in the ovary, and only requires the open tubular fold as an oviduct, and to convey the water to the pulli, which, from their position high up on the dorsal range, could not receive the ambient element without such an appendage, whilst the *K. suborbicularis* has the tube entire, as it is for some time a nidus for the young before exclusion.

I have also to add, that on opening a very large *K. suborbicularis*, I found the contents of the ovarium converted from its usual ova-like aspect into many thousands of completely testaceous young, to be further developed before their issue from the anterior tube or oviduct, without which the water could not well be conveyed and retained for the use of the young. The reason why this state of the ova has so long escaped detection is, that the ovarium has not been examined at the proper season. To see it as I have described, we must attend to the injunction of Lucretius—

"Ætheris et terræ genitabile quærere tempus."

K. suborbicularis, though often taken free in the muddy deposits of old bivalves, is also found in the crevices of the triassic rocks at Exmouth, in company with the *Saxicavæ* and *Pholades*, in which it rubs out a kind of cell, and thus becomes entitled to enter the category of the boring fraternity; it is attached by a byssus,—not merely thread-like filaments, such as the freer ones throw out when placed in a saucer, but a decided membranous white hyaline byssal lamina, which cannot be detached without some force; it always parts from the animal and is left in the cell; if it is placed in water

in a piece of hollowed-out sandstone rock, it will produce another: of these facts we speak with certainty. This species, when imbedded in the crevices of rocks, is more globular and of firmer texture than those which are found in the muddy deposits of old bivalves, taken in the coralline districts, six miles from the shore; these are very thin and almost membranous at the umbones, of larger size and subtriangular figure, and have the tube marked with flake-white longitudinal lines that are not apparent in the thicker varieties.

Having examined many of both these variations, without detecting a difference in the organs, we must consider them as dependent on habitat.

K. RUBRA, Montagu.

K. rubra, Brit. Moll. ii. p. 94, pl. 36. f. 5, 6, 7; (animal) pl. O. f. 3.

Animal suborbicular, white; mantle partially closed and with only two apertures; the anterior is the anomalous tubular projection, which is not entire as in *K. suborbicularis*, but slit open at the base, and serves as a passage for the foot. When the animal marches it is generally pushed therein, displacing the sides of the scission, which on its withdrawal assumes the aspect of an entire tube. This combined pedal aperture and tubular appendage is divided by a septum from another considerable fissure in the mantle, from which the points of the branchiæ are visible; through it the water to supply the vital principle reaches them, and when effete is expelled by the channel at which it entered; the anus is a sessile orifice completely within the slit of the mantle, and discharges therein; in fact, the fissure is the entrance of a common cavity that serves to admit the branchial water and receive the rejectamenta before exclusion. The anterior tube being nothing more than an open protrusion or continuation of the mantle, some water may reach the branchiæ through it, and be expelled therefrom in combination with the strict pedal aperture; but its principal use, as we have shown in *K. suborbicularis*, is to act as an organ of reproduction to convey water to the pulli in the matrix, which from their dorsal position could not well receive it without the aid of such an

appendage, which also serves as an oviduct. We have omitted to say, that when the fæces are received within the mantle, they are instantly ejected in light yellow or greyish cylindrical pellets. In this respect there is a difference between *K. suborbicularis* and *K. rubra*; in the former the anal orifice is protruded in a trifling degree externally, in the latter it is within the mantle.

The foot is broad at the base, long, linguiform, and has the termination rather rounded than pointed; its bluish-white hyaline texture is marked from base to point by a dull intenser flake-white line. When in a basin of sea-water, it at once attaches itself by thread-like filaments that issue from a distinct byssal fissure. The foot when exserted, but not in action, occupies a central position; it usually progresses anteally by being pushed through the anomalous fold of the mantle, and fixing itself by a species of suction, is drawn forward by muscular contraction with much vivacity, and it can also in a more limited manner progress posteriorly. The animal never remains long without forming a byssal attachment, but has no difficulty in slipping its cable when inclined to move, which is always discarded, and when required another is bent. The dark liver and yellow ovarium are situate high in the dorsal region; the latter in the genial season contains from 10–20 or more fully-formed testaceous pulli, and at the full time, the viviparous colony are ejected through the tubular fold of the mantle.

In a parcel of animals examined in the winter, the ovarium contained no young; I therefore presume that "Alma Venus" does not influence the self-sufficing loves of these Mollusca until

> ..... "species patefacta est verna diei,
> Et reserata viget genitabilis aura Favoni."

A review of these notes, and a comparison of them with those of *K. suborbicularis*, will, I think, prove that this species and its congener are nearly similar in organs, habitudes, and functions, with slight variations of specialties, and that they form a well-defined small genus which I believe only contains the two species that are described.

The habitat of this singular creature is at a far greater elevation in the littoral zone than any other bivalve, and nearly as far removed from the sea-water as the *Littorina petræa,* which in many positions is never completely submerged. These minute bivalves are plentifully imbedded in the *Lichina pygmæa,* and in the higher levels exist for weeks, without complete immersion; they are consequently deprived of regular branchial currents, which in this case can only have a very limited operation, as in even the most favourable levels they must be deprived of sea-water for very many hours out of the twenty-four. We presume, that when these animals are in elevated positions, the tides washing the bases of their rocky habitats, combined with the saline mixture of floating atmospheric particles, supply sufficient humidity for the sustentation and well-being of these singular bivalves.

MONTACUTIDÆ, Clark.

Notwithstanding our disinclination to create new families, we have no choice but to constitute the *Montacutidæ,* though it be for only a single species, the *Montacuta substriata,* a late sojourner of the *Kelliadæ.* It has little in common with *Kellia* (proper), except a partial resemblance in the structure of the hinge and presence of a byssus, but it differs essentially in the absence of the singular and anomalous anterior tubular processes, and the probable want of a viviparous reproduction. With *Lepton* and *Galeomma,* both former members of the *Kelliadæ,* now of the *Arcadæ,* to which we refer, it has nothing in common but having a byssus. With *Turtonia,* also removed from the *Kelliadæ,* it cannot be associated, from the hinge-teeth and internal long linear white cartilage, as in that genus the hinge-ligament is strictly external, and the teeth are altogether of a different composition. No existing genus or family can receive *M. substriata* without violence to natural order. Therefore, as we have undertaken a new arrangement of the *Kelliadæ,* we are bound, as far as possible, in the reconstruction, to march with malacological rigour.

The only set-off to our chagrin in being compelled to form two new families is, that they will acquire a lasting fame by their titles, in conjunction with the present generic ones, by ministering *double honours* to two of the most eminent British naturalists, Montagu and Turton.

We have already, in our preliminary remarks on the *Kelliadæ*, accounted for the disposal of the *Montacuta bidentata*, formerly of this family, by its transference to the *Anatinidæ*; and we now state that the third and last member of *Montacuta*, the *M. ferruginosa*, Brit. Moll. ii. p. 72, pl. 18. fig. 5, 5 *a* and 5 *b*, is consigned to the company of its congener, for the reasons stated under *Anatina*.

MONTACUTA, Turton.

M. SUBSTRIATA, Montagu.

M. substriata, Brit. Moll. ii. p. 77, pl. 18. f. 8 and 8 *a*; (animal) pl. O. f. 2.

Animal suboval, thick for its size. It has an oblique outline, the longitudinal measure being greater than the transverse; the body and mantle are pale yellow, the liver dark green; the mantle has a simple margin, and is largely open ventrally for the passage of a hyaline foot, that has a byssal groove at the heel, from which strong coarse filaments issue, and attach it to the ordinary habitat, the spines of the *Spatangus purpureus*: all the observed specimens were thus attached, and could not be removed without injuring the animal or shell. They were cut off by scissors, and on being placed in a watch-glass of sea-water immediately protruded the large foot, far exceeding in length the shell; it is muscular, raised in the centre, bevelled on each side to a fine awl-shaped edge, and tapers to a very rounded termination, not showing a trace of the lanceolate point. Locomotion would appear to be incompatible with the apparently fixed habitat, but it, as well as the other byssal bivalves, has the power, which we have seen them exercise, of changing place. When the animal marches the foot is extended, and its rounded termination is instantly fixed to the vase in which it is deposited;

then by the retractor muscle it is drawn forward, making such rapid progression as to cross a watch-glass in a minute, and on the passage turns itself several times by a twist of the foot from side to side. No siphonal processes, nor even a simple orifice, were observed. When opened, the large foot is the most prominent object; with a good lens the byssal fissure is distinctly visible. Though there are traces of a branchial lamina, we could not detect its configuration, nor the presence of palpi. In the hinge, under the beaks, there is a minute obsolete primary tooth or two, with only a single compressed triangular lateral, in both valves, but on the longer side only, which is the anterior one. This structure differs much from *Kellia*.

Some malacologists call what we term the lateral teeth in *Kellia* and this genus, the cardinal ones; but as in them there is no moveable ossicle, we consider the minute denticles at the edge of the cartilage-pit, directly under the beaks, the primary ones. But the case is different in those minute species styled by authors *Montacuta bidentata* and *M. ferruginosa*; these have been removed by us to the *Anatinæ*, as they have the characteristic ossicle of the family; in them there are no minute cardinal teeth, and what in *Kellia* and *Montacuta* are termed laterals, here become of cardinal value.

TURTONIADÆ, Clark.

We have been obliged to establish this family for *Turtonia*, with a single genus of only one species, planted by authors in the *Kelliadæ*, though it has not the slightest community of attributes or structure with any of the genera of that group. *Lepton, Galeomma, Kellia* and *Montacuta* are as far asunder from it as the poles. We mention a convincing proof of its heterogeneity: in all the species of those genera, excepting perhaps *Kellia suborbicularis*, in which the sides are nearly equal, the *shortest* is the posterior one; but in *Turtonia minuta* the *longest* is posterior, and it is the only animal of these tribes that has a considerably produced anal siphon.

TURTONIA, Hanley.

T. MINUTA, O. Fabricius.

T. minuta, Brit. Moll. ii. p. 81, pl. 18. f. 7 & 7 *a*; (animal) pl. O. f. 1.
Mya purpurea, Montagu et Auctorum.

I have never seen this animal, and can only record the slight notes of authors, that the foot is very large, strong, geniculated, and issues from the shorter end of the shell; the mantle is largely open anteriorly, and a slender somewhat produced siphonal tube proceeds from the longer side. The shell, except in contour, in many respects agrees with the *Lucinæ*. The ligament is external, and there are in perfect specimens two cardinal teeth? in each valve, one or both is often bifid; the teeth vary much from being deeply cloven; and thus in some examples the appearance of two, three, or four is presented, and in old shells they are otherwise confused and indistinct. The pallial impression is entire; the anterior adductor cicatrix, as in many of the *Lucinæ*, is rather more extended and at a lower level, but not much more, than the posterior one. Under the microscope we discover traces of the vertical lines so conspicuous in the margin of *Lucina borealis*; and we may also state, it is thickened, dull, and somewhat chalky in some specimens. The slender tube also allies it with that section of the *Lucinæ* which have a produced anal conduit.

The foot, when exserted, has the ordinary tongue-shaped aspect of most of the minuter bivalves, but that is no proof that it has not the singular tubular structure characteristic of the *Lucinæ*, as even in the type *L. borealis* and in *L. rotundata*, both of which beyond doubt have the true Lucinidan foot, it shows no trace of the singularity when protruded, probably from being inflated with water to produce tension. It is only when the animal is killed and opened that the curious configuration of the pedal organ is seen. We do not mean to say that *Turtonia* is a true *Lucina*, or even one at all, but merely mention these facts, which may have the value they deserve. But we will endeavour to obtain this animal. All these con-

siderations appear to support us in having transferred this species from the *Kelliadæ* to a separate family.

It is well to mention that the figure referred to of this animal is incorrect, from the engraver having placed the foot and siphon at the wrong ends; the position of each should be reversed.

CARDIADÆ.

A family of only one genus, of nine species. This is a well-marked group by its radiating ribs, which are either nodose, spinous, or vaulted, with interstitial furrows of transverse waved striæ. The tubes are short or sessile, but in some species an imperfect pallial siphonal sinus may be seen. The animal is distinguished from every other bivalve tribe by the extraordinary length of the subcylindrical geniculated foot, and by the external surface of the siphons being clothed with long pendulous filaments.

CARDIUM, Linnæus.

C. ECHINATUM, Linnæus.

C. echinatum, Brit. Moll. ii. p. 7, pl. 33. f. 2.

Animal suborbicular, pale yellow; mantle open, with the margin slightly dentated, pale brown, forming a branchial and anal siphon, which are ¾ of an inch long, in a shell of about an inch-and-a-half vertical and transverse measure; they are of a dirty white hue, united or soldered on each other, and have not the aspect of a single sheath; the anal is rather the shortest and smallest, and protrudes a plain globular valve at its termination; each is fringed with about 15–20 white cirrhi, having at their bases short, dark yellow, and minute close-set brown lines, which give the orifices of the siphons the appearance of being encircled by a fine line, and on the external surface of each there are long, somewhat curved white filaments, which also for a short distance clothe the mantle above and below them. The foot is subcylindrical,

narrow, geniculated, and of flesh colour, the result of a delicate and easily obliterated epidermis, under which it is pure white; its length is at least twice that of the shell. There are a pair of semi-oval branchiæ on each side, the upper one being as long as the lower, but not half the depth of it; they are pale brown and well-striated on the outer surface, but less so within; the palpi are of the same colour, very long, slender, pointed, with decided raised vessels on the inside, though less marked externally.

We subjoin a separate account of the young shell, which is the *C. ciliare* of authors, and has been considered as belonging to the *C. aculeatum*; but having had opportunities of examining large suites of both species of $\frac{1}{8}$th of an inch to $2\frac{1}{2}$ inches diameter, we can confidently state that it is the young of this species.

C. ECHINATUM, jun.

C. ciliare, Auctorum; Brit. Moll. (animal) pl. N. f. 4, as *C. echinatum*, jun.

Animal suborbicular; the specimen examined was $\frac{3}{8}$ths of an inch diameter, pale yellow; the mantle is muscular, and coarsely dentated at the edge, which character in a great measure disappears in the older shells; it is open throughout, forming short tubes, the branchial one having about sixteen short cirrhi and minute red points at the base; the anal siphon has the usual tubular retractile process and twelve cirrhi, which also have red points at the base; besides the siphonal cirrhi, there are above and below and on the tubes a few coarser white filaments, which are invariable appendages of all the *Cardia*. There are on each side the body a pair of pale brown roughly striated suboval branchial laminæ, the upper being much narrower than the under ones; the striæ are apparent on both surfaces; the corresponding pairs of palpi are long, narrow, subtriangular, pointed, and rather more strongly striated on the inner than on the outer sides; they are pale brown. The foot is very long, at least double the vertical measure of the shell, subcylindrical, narrow, pointed, angulated, and of a pale flesh colour.

This species is taken abundantly at Exmouth, of all sizes, in the coralline zone.

C. EDULE, Linnæus.

C. edule, Brit. Moll. ii. p. 15, pl. 32. f. 1–4; (animal) pl. N. f. 5.

Animal suborbicular; the body is large, subglobose, and of an opake white; mantle pale yellow, edge fringed. The siphonal apparatus forms two short conical tubes, separate from their bases, and divergent; the branchial has ten long white cirrhi, with two or three intermediate shorter ones springing from the orifice, which is encircled by a dark or red-brown line; the anal tube has a similar line, but no cirrhi; it is provided with a retractile tubular valve; both tubes have on their surfaces the usual characteristic curly white filaments, and they vary from whitish to pale yellow or reddish-brown. The foot is considerably smaller than in any of the other *Cardia*, and has very little of the long cylindrical aspect of that organ in its congeners, being rather flat and lanceolate; its colour varies from opake white to pale brown or yellow. There are a pair of moderate-sized, pale brown, suboval branchiæ on each side, finely pectinated, the upper one being much the smallest; the palpi are red-brown, longish, pointed, flat, and subtriangular, smooth on the outside and pectinated within.

There are many varieties of this common species which result from habitat; they are sometimes excessively thin, arising in certain estuaries from a more than usual affusion of fresh with the salt water, and under those conditions have been named by some naturalists *C. rusticum*. It is proper to observe, that the true Linnæan *C. rusticum* is a very different species, which has long been known to collectors, though misnamed *C. tuberculatum*, the strongest and most ponderous of all the *Cardia*. The young of one of the varieties, from its umbonal transverse bands, has been mistaken for our *C. fasciatum*, the *C. elongatum* of some authors, but the oblique outline of the latter species will always distinguish it from any of the young fasciated varieties of *C. edule*.

C. FASCIATUM, Montagu.

C. fasciatum, Brit. Moll. ii. p. 25, pl. 32. f. 5; (animal) pl. N. f. 3.
C. elongatum, Auctorum.

Animal suborbicular, body flake-white; mantle plain. Siphonal tubes not exserted usually above $\frac{1}{8}$th of an inch, of the same length, united, each with ten simple white cirrhi, and on them are the invariable filamentous appendages. The foot is long, narrow and subcylindrical, or finger-shaped, and, contrary to the *Cardia* in general, hyaline. The branchiæ are subsemicircular, pale brown, the upper one not half the size of the lower, strongly striated on the outside and smoother within; the palpi are very short, triangular but pointed, striated on the outer, and much less on the inner surface. The liver is green and very anterior; the ovarium white, and full of ova on 4th of August.

It inhabits the coralline zone, and is rare at Exmouth.

C. NODOSUM, Turton.

C. nodosum, Brit. Moll. ii. p. 22, pl. 32. f. 7.
C. muricatulum, juv., Auctorum.

Animal subglobose; mantle open, edged with white pointed filaments issuing from the points of the mantle corresponding to the ribs. The siphons are pale yellow and very short, each with ten or twelve flake-white cirrhi at the orifices and red points at the bases, with the addition of the curved white filaments above, below, and on the tubes; the anal one protrudes the usual retractile valve. The foot is white, moderately long, subcylindrical, and slightly geniculated. There are a pair of semi-oval branchiæ on each side, the upper is not half the length and breadth of the under one; they are strongly pectinated on the upper, and less on the lower surface; there are two very small triangular palpi on each side, pectinated in a similar manner with the branchiæ.

This species, at Exmouth, is only met with in the coralline zone, but it is not uncommon.

We have ascertained by a comparison of the *C. muricatulum* of authors, of sizes of less than $\frac{1}{10}$th–$\frac{2}{10}$ths of an inch dia-

meter, with the animals of the *C. nodosum*, that they are identical.

If it had been our practice to generalize, the singular sameness of the organs of this genus would have authorized a departure from the plan of detailing the specialties of every case: the present work is not intended to be subjected to the dull and heavy labour of being doggedly read through consecutively; we consider it one of particular reference, and think that we have done good service to the reader in stating the specialties at length in nearly every case.

C. NORVEGICUM, Spengler.

C. norvegicum, Brit. Moll. ii. p. 35, pl. 31. f. 1, 2; (animal) pl. N. f. 1.
C. lævigatum, Auctorum.

Animal thick, suboval, elongated, the vertical measure exceeding the transverse; the mantle is closed throughout the posterior range, and at its lower part forms two short siphons united at their bases and divergent at the extremities, of a pale yellow, marked with flake-white spots and lines; the branchial tube is rather the shorter, but of greater diameter, and is rarely extended more than half an inch; its orifice is circled with twenty long yellowish-white cirrhi, having dull red-brown markings around their bases; the anal siphon is simple, and has the usual retractile valve, which is marked on the lower and upper surface with a faint red-brown line, and points of the same colour at the termination. The siphons and the posterior range are clothed with thick-set pale reddish-brown and pale yellow curved filaments. The mantle, from the point where the filaments terminate, is simple and open, with its outer and inner margin of a flesh colour, and affords a passage to a long, powerful, geniculated, cylindrical foot, that has a pointed termination; its substance is rigid, and, except the white point, of a red flesh colour, which the slightest touch removes and shows the white ground; it is longer than the greatest measure of the shell, and its epidermis appears shagreened and marked with anastomosing fine lines. There are on each side a pair of pale brown suboval branchiæ, with the margins of a deeper brown; the upper one is considerably

smaller and of less depth than the under one; they hang more vertically than those of its congeners, and the transverse pectinations are more conspicuous without than within; the palpi are very long, triangular, united by a labium around the mouth, and with the branchial laminæ by a membranous filament; they are more strongly striated on the inner than on the outer areas.

This elegant species is frequently obtained by the dredge in the coralline district at Exmouth.

The following species have not occurred to us alive:—

C. RUSTICUM, Linnæus.

C. rusticum, Brit. Moll. ii. p. 11, pl. 31. f. 3, 4.

C. ACULEATUM, Linnæus.

C. aculeatum, Brit. Moll. ii. p. 4, pl. 33. f. 1.

C. PYGMÆUM, Donovan.

C. pygmæum, Brit. Moll. ii. p. 29, pl. 32. f. 8; (animal) pl. N. f. 2.

C. SUECICUM, Reeve.

C. suecicum, Brit. Moll. ii. p. 33, pl. 32. f. 6.

The last may be a young delicate var. of *C. edule*.

MACTRIDÆ.

This is one of the old Linnæan families, with only a single genus, so distinctly characterized as to require few remarks; it contains four British species. By its open mantle and short tubes it is allied to the *Veneres*, but we cannot concur in the opinion of some authors, that it presents many features of the *Myadæ*. We take the liberty of saying, that it will be very difficult to find a single accordant point between the two families, except the generalities of every bivalve. *Mactra* and *Mya* are far asunder: the former has the mantle open, short tubes, and very circumscribed in length, suboval, broad branchiæ; in the latter, the branchiæ are narrow, elongated, with a part of them lying in the branchial tube; the mantle is quite closed, and the siphonal apparatus particularly long. The dentition of the two families is entirely different, with the

exception of the V-shaped tooth in *Lutraria*, which genus in our method belongs to the *Myadæ*.

MACTRA, Linnæus.

M. STULTORUM, Linnæus et Auct.

M. stultorum, Brit. Moll. i. p. 362, pl. 22. f. 4, 6; and pl. 26. f. 2.

Animal suboval, of the palest bluish-white; mantle open throughout the ventral range, its edge is clothed with a delicate intensely white fringe of short filaments; both siphons are short, of the same length, united, covered by a fine brown deposit, which appears to be independent of the epidermis on the shell; the united tubes are never exserted more than half an inch, their orifices are fringed with simple dirty pale red cirrhi; the branchial, which is the longest, with 12–16, the anal has 14–20. The lower part of the body is white, and the dorsal range, containing the brownish-green liver and ovarium, of a dull opake white. The foot is thick, long, bevelled to a sharp margin, and extensible from all the phases of obtuseness to the pointed lanceolate extremity. There are on each side the body two suboval, brown or drab-coloured branchiæ, the upper the smallest, and obliquely very finely striated by the vessels of the circulation. The palpi are long, triangular and pointed, of an opake brown, more distinctly pectinated than the branchiæ, particularly on the inner surface. It has been omitted to be stated that the anal tube is provided with an exsertile hyaline valve, and our experience positively entitles us to say, that the anal tube of almost every bivalve is usually furnished with that appendage, the use of which is doubtless to regulate the entry and issue of the water, which has probably a communication with the ovarium, as well as for other functional purposes, which are alluded to in our remarks on the *Pholadidæ*, in the section on the branchial currents. This tubular retractile valve is never attached to the branchial siphon; at least we can bring no instance of its presence to our recollection.

This is a littoral animal, and often, after a gale, is abun-

dantly cast on the Warren Sands, at Exmouth, from whence we obtained our finest specimens.

M. SUBTRUNCATA, Da Costa.

M. subtruncata, Brit. Moll. i. p. 358, pl. 21. f. 8; and pl. 22. f. 2; (siphons) pl. L. f. 3.

As the external organs of the *Mactræ* are very similar, it will only be necessary to mention the variations of some of the succeeding species from the *M. stultorum*, which may be considered the type of the genus. The present animal differs in having no fringe to the margin of the mantle, at least none could be detected; the siphons are united as in *M. stultorum*, and clothed with an evanescent epidermis; the orifices have simple pale red, white or yellow cirrhi; and we may conclude our account by observing, that the branchiæ and palpi are of a pale brown, and that the foot is of a paler yellow, narrower than in its congener the *M. stultorum*. We have in this instance, and one or two others, departed from the usual plan of a detailed description; it is an example of the inconvenience attendant on the omission, as we are here obliged to have recourse to our notes of another species to complete the present one. We think, if possible, such references should be avoided.

M. SOLIDA, Linnæus.

M. solida, Brit. Moll. i. p. 351, pl. 22. f. 1, 5; (siphons) pl. L. f. 2.
M. truncata, Brit. Moll. i. p. 354, pl. 23. f. 1; and iv. p. 253.

The animal, like the *M. stultorum*, has the margin of the mantle fringed; the siphonal canals, as to structure and arrangement, are the same as in the two former species, and of a pale brown colour; the branchial one, which is the largest, has about sixteen, and the anal twenty, shorter pale yellow, or brown, or reddish cirrhi at their orifices, which vary greatly in different localities. The branchiæ and palpi differ from the preceding animals in being of a deeper brown, with a decided reddish hue; otherwise they are of the same shape, and nearly with similar pectinations. The *M. solida* varies in shape in every locality; in some it is flat-sided, tumid, and

triangular; in others, compressed, sharp at the sides, and transversely produced, which variations have caused even the excellent Montagu to err in the creation of his *M. truncata* from one or other of the varieties of the *M. solida* or of the *M. subtruncata*. Without being positively certain, we think the *M. truncata* of authors must be expunged as a species; and whether it be a synonym of the *M. solida* or *M. subtruncata* is doubtful; at any rate, all the shells that have been as yet shown us are referable to one or other of these species.

The contour of the *M. solida*, which is taken abundantly at Exmouth at low water, in the sandy ranges adjoining the Mare rocks, is of the tumid and subtriangular variety: it is from this locality that Dr. Turton obtained the types of his *M. crassa*.

M. ELLIPTICA, Brown.

M. elliptica, Brit. Moll. i. p. 356, pl. 22. f. 3; (animal) pl. L. f. 1.

Animal suboval, compressed; body flake-white; liver green, scarcely visible, being covered by the opake white tough dorsal skin; mantle open, very slightly fringed anteally, plain posteally; siphonal tubes in a specimen $\frac{3}{4}$ of an inch transverse by $\frac{1}{2}$ an inch vertical measure, are not exserted more than $\frac{3}{8}$ths of an inch, and appear as if enveloped in a sheath; each orifice has about twelve cirrhi at their bases, below which a bright orange line encircles the sheath, which is of pale yellow. The branchiæ are light orange, subsemicircular, the upper being much smaller than the lower, and very finely pectinated. The palpi are long, narrow, pointed, pale brown, and more conspicuously striated than the laminæ. Foot white, rather large, muscular and lanceolate, by the aid of which the animal turns its shell, with great ease, from side to side.

This species appears distinct, and though it is difficult to define distinctions by the organs, which in all the *Mactræ* are so similar, still there is a delicacy and elegance in the appearance of this creature which almost assures us that it is not a dwarfish variety of the *M. solida*, which at Exmouth is strictly a

littoral species, while the *M. elliptica* is never taken, except by the dredge in the coralline zone, six miles from the shore.

M. HELVACEA, Chemnitz.

M. helvacea, Brit. Moll. i. p. 366, pl. 23. f. 2.
M. glauca, Anglorum.

This splendid shell is not British. We have the authority of the French oystermen who bring cargoes of oysters into the port of Exmouth, to plant in the parks, on the Exe, at Lympstone, that it does not even inhabit the Guernsey or Jersey grounds, and that it is a French littoral or laminarian species, and only taken on the in-shore oyster-beds. We have often procured it, the *Pileopsis hungaricus*, *Calyptræa sinensis*, and large Guernsey *Chitons*, by overhauling the cargoes. Dead valves have been taken on our coasts, either cast thereon by storms or from discharged ballast, a fertile source of spurious species. Near thirty years since, Miss Pococke, daughter of Admiral Pococke, the *original* assigned authority for this species as *British*, in person, at Bath, presented the author with two pair of the *M. helvacea*, taken by herself on the extensive sandy districts of Cornwall; but she by no means guaranteed their being indigena, and with perfect frankness stated every particular of their acquirement, which scarcely admitted a doubt of their being aliens to Britain.

CYPRINIDÆ.

This family consists of four genera, *Cyprina*, *Isocardia*, *Circe*, and *Astarte*; the first three have only one species in each, and *Astarte* six or seven. We have described *Cyprina*, *Isocardia*, and *Astarte*. With respect to *Circe*, it has not occurred to us alive; but in the essentials of family configuration, of there being no cicatrix in the pallial impression, showing that the tubes or orifices are short or sessile, it agrees with its congeners. It is remarkable that the coasts of Devon give name to the *Astarte Damnoniensis*, yet, in the forty years we have dredged those localities, neither a living nor

dead specimen of that species has been taken; but we have often seen the minute *A. triangularis* alive. *Cyprina* and *Isocardia* by their hinges indicate some alliance with the *Cardiadæ*.

This family has considerable affinities with the *Veneridæ*, but is distinguished by the very short, almost sessile siphons, and the consequent absence of pallial impression so conspicuous in that group.

CYPRINA, Lamarck.

C. Islandica, Linnæus.

C. Islandica, Brit. Moll. i. p. 441, pl. 29; (animal) pl. M. f. 4.

Animal suborbicular, thick, bluish-white; mantle open, powdered for some depth, on a pale yellow ground, with minute red-brown sandy points; its edge is finely dentated and marked with a slender brown line. The foot is thick at the base, moderately long, linguiform, and posteally lanceolate. The mantle forms no tubes, but mere sessile orifices, both of which are ciliated; the branchial is the largest, having about twenty simple cirrhi, the anal about ten; both are tinged with red-brown; the anal orifice at its terminus frequently protrudes a globular transparent membranous valve, which regulates the entry and issue of the water; the margins of both orifices at the base of the cirrhi have a girdle of a narrow bright red line, the hues of which vary in individuals even from the same locality.

This species usually inhabits the littoral sandy districts, but at Exmouth is obtained in an offing of five or six miles.

ISOCARDIA, Lamarck.

I. cor, Linnæus et Auct.

I. cor, Brit. Moll. i. p. 472, pl. 34. f. 2; (animal) pl. N. f. 6.

"Animal globular; mantle completely lining the shell, double at the outer edge; exterior fold divided in front, open

at each end; at the posterior extremity forming two short siphons or tubes, ciliated at the orifices; colour yellowish-white; margin orange. Foot very muscular, broad, triangular, compressed, pointed, orange. Branchiæ external, concealed between the mantle and the body. Body soft, completely included within the valves. On being placed in a vessel of sea-water the valves of the shell gradually opened; the feelers or ciliated fringe of the upper orifice moved slowly, as if in search of animalculæ. Having remained in this situation about ten minutes, water was ejected with considerable force from the lower orifice, which till now had remained motionless. The expulsion of the water appeared to be effected by a sudden contraction of the muscles, because this was never done without the valves closing at the same instant. After a few seconds the valves gradually returned to their open position, and remained quiescent as before till the water was again ejected with a jerk. This alternating process was repeated at unequal intervals during the whole time my specimens were under examination, but at shorter intervals on receiving fresh supplies of sea-water, when I suppose the food, the quality of which I could not ascertain, was more abundant. The animal appears to be insensible both to sound and light, as the presence or absence of either did not at all interrupt its movements, but its sense of feeling appeared to be very delicate; minute substances dropped into the orifice of the mantle instantly excited the animal, and a column of water, strongly directed, expelled them from the shell. With so much strength was the water in some instances ejected, that it rose above the surface of three inches of superincumbent fluid. Animal small in proportion to the shell, occupying, when dead, barely a third of the space enclosed in the valves. The mantle is slightly attached to the shell and to the epidermis at the margin, and appears to be kept distended, and in contact with the interior of the valves, by the included water. The valves fit so closely that the animal can remain two days or more without permitting a single drop of fluid to escape. Locomotion very confined. It is capable, with the assistance of its foot, which it uses in the same manner, but in a much

more limited degree, as the *Cardiaceæ*, of fixing itself firmly in the sand, generally choosing to have the umbones covered by it, and the orifices of the tubes of the mantle perpendicular. Resting in this position on the margin of a sand-bank, of which the surrounding soil is mud, at too great a depth to be disturbed by storms, the *Isocardia* of our Irish Sea patiently collects its food from the surrounding element, assisted in its choice by the current it is capable of creating by the *alternate opening and closing of the valves*."

I have been tempted to copy the Rev. James Bulwer's account of this animal from the second volume of the 'Zoological Magazine,' rather than refer to it, as it singularly corroborates my views of the mode in which the branchiæ of bivalves are supplied with water. That gentleman, after many days' examination, expressly states that the ingress current of water was effected by the opening of the valves, and which was expelled by their closure at the branchial orifice. This statement negatives the doctrine of branchial currents by cilia, and ingress and egress currents by separate apertures, that is, by the water being received by the branchial siphon or orifice and discharged from the anal one; besides, this result is anatomically impossible, as all my experiments—at least in the closed-mantle bivalves with elongated siphons — appear to prove that there is no communication between the anal and branchial tubes. In this species, the mantle being open, the branchiæ receive the water from the great ventral range, and it is expelled by the same channel.

We are of opinion that the branchial cilia, the motive agent of the water with many authors, have no other function than to divide it, to facilitate the extraction of the vital influence.

We strongly recommend those naturalists who advocate the doctrine of branchial currents by cilia and distinct siphons or apertures, carefully to consider Mr. Bulwer's account, who at any rate must be looked on as a disinterested observer, and has no object in supporting a particular theory.

This genus is artificial, and originates in the shape of the shell; the animal is so similar to that of *Cyprina*, that *Isocardia* might very well merge in it.

CIRCE, Schumacher.

C. MINIMA, Montagu.

C. minima, Brit. Moll. i. p. 446, pl. 26. f. 4, 5, 6, 8; and (animal) pl. M. f. 3.

The animal has not occurred to us alive.

ASTARTE, Sowerby.

A. SULCATA, Da Costa.

A. sulcata, Brit. Moll. i. p. 452, pl. 30. f. 6; and (animal) pl. M. f. 5. and iv. p. 254, pl. 30. f. 5, 6, and pl. 133. f. 4.
A. elliptica, Brit. Moll. i. p. 459, pl. 30. f. 8.
Venus scotica and *Damnonia*, Mont. et Auct.

The animal has not been found on the Devon coast.

A. ARCTICA, Gray.

A. arctica, Brit. Moll. i. p. 461, pl. 30. f. 7.

Animal unknown. ? British.

A. CREBRICOSTATA, Forbes.

A. crebricostata, Brit. Moll. i. p. 456, pl. 30. f. 9.

Animal unknown. ? British.

A. COMPRESSA, Montagu.

A. compressa, Brit. Moll. i. p. 464, pl. 30. f. 1, 2, 3.
Venus compressa, Mont. et Auct.

This very common Scotch species has not occurred alive.

Of the above, the *A. arctica* and *A. crebricostata* are very doubtful indigena.

A. TRIANGULARIS, Montagu.

A. triangularis, Brit. Moll. i. p. 467, pl. 30. f. 4.
A. minutissima, Auctorum.

Animal occupying a subtriangular yellow or brown strong smooth shell, crenated at its edges when adult, plain when

young, in which state it forms the *A. minutissima* of authors. The general colour of the animal is white; the mantle is largely open, with plain margins. There are no siphons; the anal orifice is sessile. I am unable to say if there is a distinct aperture for branchial functions. The mantle may be entirely open to the anal conduit, receiving the water throughout the ventral range. The foot is finger-shaped, and when much exserted a posterior geniculation is seen; it is hyaline, mixed with snow-white flakes. No other organs could be seen; indeed its minuteness will not allow of any remarks on the branchial structure. The animal was lively, and on the march turned from one side to the other.

Taken in the coralline zone at Exmouth, 1852.

VENERIDÆ.

This beautiful and numerous family, if we take into account the exotic species, is, as regards the British indigena, confined to very moderate dimensions, and in our method only includes the two genera, *Venus* and *Pullastra*. With our views of the unnecessary and artificial extension, by the moderns, of many of the Linnæan genera, with scarcely a trace of difference of essential animal organization to support them,—for surely a tooth more or less is not an essential point,—we entirely concur with M. Deshayes in merging *Cytherea* in *Venus*. We examined, about twenty years ago, at Exmouth, a full-grown live specimen of the Cytherean type, the *Venus Chione*, but we can offer few remarks on its specialties, as, unfortunately, notes were not made on it; at present we only observe, that it is as decidedly a typical *Venus* in every essential point as any of the race. We have also no hesitation in consigning the *Artemis* of authors as a section of the *Veneres*, though it is said that the foot and coalition of the siphonal tubes vary from *Venus*; but having repeatedly seen the *V. exoleta*, the type, alive, we can state, that its organs are of the same configuration. The *V. lincta* has not been met with, and is the

only other British species that has been handed over to *Artemis*.

The genus *Pullastra* of Sowerby is maintained, though M. Deshayes says that the differences between it and *Venus* are still less than in *Cytherea*. We do not concur in this opinion, as that eminent naturalist has overlooked the byssal groove, which essential character, with the general aspect of the group, throwing in as a make-weight the slenderness and parallelism of the teeth, have determined us to adopt it as sufficiently well based on organization.

The animals of this family are so extremely similar, that we call in aid their shell-specialties to assist in constituting sections, to facilitate a divisional arrangement for easy identification. The first section comprises the typical *Veneres*, which have three strong teeth in each valve; the second section contains those with four teeth in one valve and three in the other, with a hollow or pit as the receptacle of the isolated tooth; these are those which authors have deposited in *Cytherea* and *Artemis*.

The hard parts of all the species are of very strong and compact texture; their shape is either orbicular tumid and lentiform, or a more or less elongated oval; all have deep siphonal cicatrices, and none have lateral teeth, unless the isolated one of the second section be considered a vestige of one. The animal of *Venus* has no byssal groove, but I believe that of *Pullastra* has always that appendage. But these remarks need not be extended, as it will be seen by the specialty descriptions that there are few peculiarities in this old aristocratic family, in which there is little more to do than to ring the changes on trivial points.

As I have mentioned the terms *Veneridæ* and *Cytherea*, and in another place the genera *Solenicurtus* and *Venerirupis*, it may not be improper to make a few remarks on the incorrect Latinization of nomenclatural appellations. This essential appendage of natural history is admitted by all not to be in a satisfactory position, and I will not go beyond the present pages to demonstrate the truth of these opinions. It is the custom of authors to write *Venerupis* for *Venerirupis*, *Sole-*

curtus for *Solenicurtus*. The first may signify a vein of the rock, and the second some connection with the sole of the shoe, or with the Sun, from *Sol, solis*; but there can be no mistake in the correct readings *Venerirupis* and *Solenicurtus*, which emphatically declare, the one, to be a rock *Venus*, and the other, allied to the animal of the *Solenes*. It may perhaps be said, that these are very unnecessary objections; every one knows what is meant. But that is not a sound reason for writing incorrectly, when it is as easy, without being too fastidious, to have some regard to a just etymology. We may add, that if *Venerupis* is correct, to be consistent, it would be necessary for the family of the *Veneridæ* to be written *Venidæ*. It is the continual neglect of these apparent minutiæ that has brought our nomenclature to its present degraded condition. We think, if these points are properly considered, they will be admitted to be essential. These observations are not strictly my own; I may say, *non meus hic sermo*; but I have for them the high authority of a valued friend, now no more, Dr. Goodall, the late Provost of Eton, whose dicta on philology few will dispute, and with whom I have had frequent conversations on the corrupt position of the nomenclature of all the branches of natural history. That learned gentleman, from his profound classical ear, was particularly sensitive on these points and mispronunciations. I well recollect, when chatting together at my house, I pronounced the genus *Cytherea* with the accent on the second syllable, when with offended ear he thundered forth—

Parce metû, Cȳthĕrēa; manent immota tuorum.

And yet, with those who ought to know better, we continually hear the word spoken with the accent on the second syllable, instead of the penultimate. I am aware, when the island *Cythera* is in question, the accent is long on the second syllable—

. . . . . alta Cythēra,—

but never in *Cȳthĕrēa*. The reproof I received has made a permanent impression, and I have endeavoured to avoid similar error. My object in relating this anecdote is to excite the

attention of naturalists to the important consideration of nomenclature, and to prevent, at least, additional error, if it be impossible to rectify the present barbarisms.

Section I. *Three strong teeth in each valve.*

VENUS, Linnæus.

V. FASCIATA, Donovan.

V. fasciata, Brit. Moll. i. p. 415, pl. 23. f. 3, and pl. 26. f. 7; (animal) pl. L. f. 7.

Animal compressed, body flake-white; mantle open, thick and muscular, bordered with fine white fringe. The siphons are very short, soldered on each other, just separate at their extremities; the anal is the smaller, slightly curving upwards, furnished with a flexible hyaline valve, and fringed at the orifice with about fifteen plain white cirrhi; the branchial has twenty rays of similar cast; both the tubes are of a pale sulphur-yellow, with flaky markings and margined with a fine red line, and are aspersed from their bases with minute sand-like red points. On each side there are a pair of pale brown suboval branchiæ, the upper being much the smaller and strongly striated on both surfaces; the palpi are small, pointed and triangular, externally smooth, but striated across the inner surface. The foot, at rest, is securiform, apparently scarcely detached from the body; when extended — but it is rarely seen so—it is thick, moderately long, and lanceolate. The colour pure white.

Common, alive, in the coralline zone at Exmouth.

V. STRIATULA, Donovan.

V. striatula, Brit. Moll. i. p. 408, pl. 23. f. 4, and pl. 24. f. 4, and pl. 26. f. 9, 10, 11.

Animal white; mantle open throughout the ventral range, having the margin fringed with short fine white filaments. The siphons are rather slender, and when extended are about

half the length of the shell; they are of equal length, and united to their extremities; both have fine red-brown cirrhi at their orifices, which, when the tubes are not fully protruded, are retracted, and give them at that point a naked or truncate aspect; a good lens is required to detect the cirrhi in this small species. The siphons are pale bistre, and sprinkled with minute red-brown points. The foot is pure white, thickish, and when in action of the usual tongue-shaped sublanceolate form, and slightly angulated at the heel. A pair on each side of suboval pale brown branchiæ, and of still paler palpar appendages are fixed in the usual position; the upper laminæ are smaller, of less depth than the under, and more coarsely striated; the palpi are of the usual triangular form, striated more distinctly on the inner than on the external sides.

Common, alive, at Exmouth in all districts.

V. OVATA, Pennant.

V. ovata, Brit. Moll. i. p. 419, pl. 24. f. 2, and pl. 26. f. 1; (animal) pl. L. f. 6.

Animal suboval, pale bluish-white, the body being of a deeper flake-white; mantle open, with the margin fringed with simple thick-set short white filaments. The siphonal tubes in a full-grown animal are rarely exserted more than $\frac{3}{8}$ths of an inch, of the same length and united, each with about twenty pale yellow cirrhi, that is, ten long and ten alternate shorter ones; the orifice of each siphon appears encircled with a fine line, in consequence of each cirrhus having a minute point of that colour at its base; the anal tube has the hyaline valve. There are on each side of the body a pair of very oblique pale yellow suboval branchiæ; the upper, as usual in this tribe, much the smaller; they are more striated on the inner than outer surface; the palpi are short, small, triangular, and striated as the branchiæ. Foot snow-white, very long, thick, almost cylindrical, and capable of great extension posteally and anteally.

The present species is common, alive, at Exmouth. The *V. pallida* of Turton is exotic.

V. VERRUCOSA, Linnæus.

V. verrucosa, Brit. Moll. i. p. 401, pl. 24. f. 3.

We have seen the animal alive at Exmouth, but have mislaid our notes.

V. CASINA, Linnæus.

V. casina, Brit. Moll. i. p. 405, pl. 24. f. 1, 5, 6.

We have not seen this species.

Section II. *Four teeth in one valve and three in the other, with a pit to receive the isolated one.*

V. CHIONE, Linn. et nobis.

Cytherea Chione, Lamarck et nonnull.
——— ———, Brit. Moll. i. p. 396, pl. 27. and (animal) pl. L. f. 8.

We can at present only refer to our preliminary remarks, and state, that this species will not be found to differ from our Veneridan descriptions, except in minor points.

V. EXOLETA, Linn. et nobis.

Artemis exoleta, Poli et nonnull.
——— ———, Brit. Moll. i. p. 428, pl. 28. f. 3, 4.

Shell suborbicular, very convexly lentiform, having the striæ of increase close-set, concentric, flattened, slightly reflexed, and under a powerful lens finely striated in a vertical direction, the surface being often marked with pencils of red, bistre, and dark purple, which radiate from the beaks to the ventral range; some specimens are milk-white, and others with irregular blotches, which sometimes simulate a sort of Arabic characters. There are three teeth in the left valve and four in the other. The margins of the shell are smooth.

Animal. General colour pale yellow-white; mantle open from the anterior depression to the siphons; the margins are fringed with close white cilia, which are most distinct anteally, but as they approach the posterior end become less pronounced, and are resolved into dentations. The siphons are short, scarcely protruding beyond the shell; some authors say, "siphonal tubes long." We think this is an error; they are

united, of much the same size, rufous around the orifices; the upper almost plain or with a few scalloped points; the branchial has eight short dull rufous cirrhi. The foot is very large, occupying nearly the ventral range, and always presents itself as of a securiform figure; the heel is rather slender and bluntly pointed, but the rest of the foot can sufficiently protract itself to represent a thick, short, strong, broad linguiform organ; its pure white colour is relieved by beautiful vertical lines of brilliant snow-white. There are a pair of pale brown gill-plates on each side of what are called suboval figures, which in this case stand thus :—the dorsal attachment is linear, the free edge curved, expanding posteally in a rounded form, and attenuating as it approaches the buccal orifice; the upper lamina does not cover the under one; both show a mixture of coarse and fine striæ, the larger being probably the inter-branchial tubes, and the smaller the parallelogrammic meshes. On each side there are a pair of short triangular palpi, strongly striated transversely within, and less so on the outward surface. The liver is brownish-green. The animal is shy and apathetic; the locomotion consists in screwing the shell on its axis, and turning it from one side to the other.

In the coral zone at Exmouth.

V. LINCTA, Pulteney et nobis.

Artemis lincta, Poli et aliorum.
——— ———, Brit. Moll. i. p. 431, pl. 28. f. 5, 6.

This species has not occurred alive, but fresh shells are frequently taken with the last species.

PULLASTRA, Sowerby.

P. PULLASTRA, nonnull. et nobis.

Venus pullastra, Auctorum.
V. perforans, Auctorum.
Tapes pullastra, Brit. Moll. i. p. 382, pl. 25. f. 2, 3; (animal) pl. L. f. 5 & 5 *a*.

Animal thick, oblong, of the palest bluish-white; mantle

open, having the anteal and posteal portions of the margin dentated, the middle is smooth and gently sinuated. The siphons, when extended, are fully as long as the shell, and united to about ¼ of an inch from their extremities, when they become well separated, the anal one curving upwards, the branchial inclining downwards; the former is circled with 20–30 pale brown short cilia, sometimes tipped with white, the latter with a variable number of longer brown or pale red ones, each being fringed on both sides with short horizontal white fimbriæ; there are also 16–30 shorter intermediates, some plain white, some brown and fimbriated on both margins; the siphons are white, except a short area at their terminations below the cilia, of red-brown dark bistre, or of those colours mixed, and marked with short fine red transverse lines and longitudinal blotched ones. A pair of pale brown branchiæ on each side; the upper laminæ not covering the lower, decussated on both surfaces by the network of the blood-vessels; the palpi are small, triangular, striated on the inner surface, and smooth without; the posterior ends of the branchiæ are permanently fixed in this species and the *P. decussata* to the roof of the branchial tube, as in *Pholas*.

The *Venus perforans* of authors is only a dirty-white or ochraceous specimen of this species, arising from the exclusion of light, in consequence of its habitat being adventitiously cast on rocks, where, like the *Saxicavæ* and other excavators, it has the power of imbedding itself. We have carefully examined and compared with them many of the free shells from the shingles, and have not detected the slightest specific difference: we consider the two identical. The foot of this species is pure milk-white, with a byssal groove producing fine filaments, which, when the animal is not in pure sand, attach it to the shingle; it is muscular, slightly geniculated, and lanceolate.

This is strictly a littoral species, never being met with in the dredge, and is scarce on the shingle tracts at Exmouth.

The variety, the *V. perforans* of authors, is abundant, being imbedded with the *Pholas dactylus* in the red sandstone at the same place.

P. DECUSSATA, Linn. et nobis.

Venus decussata, Auctorum.
Tapes decussata, Brit. Moll. i. p. 379, pl. 25. f. 1.

Animal thick, suboval, very pale creamy-white; mantle open, with the margins finely scalloped or dentated. Foot large, muscular, angulated, lanceolate, white, with a byssal groove. Tubes subcylindrical, gently tapering, separate from their bases, of the same length, and, when extended, as long as the transverse measure of the shell; they are at times greatly inflated; the colour, to within a quarter of an inch of the orifices, is pale yellowish-white, interspersed with whiter minute flakes, and marked for about an inch at their terminations with confused yellowish-tawny or dark brown short lines or blotches; both the orifices are fringed, the branchial with about twelve long cirrhi with alternate smaller ones; the anal has 16–20 of the same size, and generally both are of a bistre colour; the siphons, at the animal's will, diverge in various directions. There are a pair of suboval branchiæ on each side, the upper the smaller; they are more strongly pectinated on the inner than on their external areas, of a pale brown, aspersed with minute dark brown points. The palpi are very small for the size of the animal, triangular and striated as the branchial laminæ.

This species is much more common than the *P. pullastra*; they live together in the same shingles, and have precisely the same habitudes; notwithstanding this community they are very distinct species.

P. VIRGINEA, Linn. et nobis.

Tapes virginea, Brit. Moll. i. p. 388, pl. 25. f. 4, 6.
—— *aurea*, Brit. Moll. i. p. 392, pl. 25. f. 5.
Venus Sarniensis, ænea, nitens, Turt. et Auctorum.

Animal inhabiting a suboval shell, furnished with close-set, blunt, rounded, stout, subconcentric striæ; the ground colour is pale yellowish-white; the mantle is open throughout the ventral range, with its margins anteally dentated, medially sinuated, and posteally crenulated, with a few short yellow filaments at each extremity; the animal emits anteriorly the

usual thick fleshy linguiform foot, very moderately geniculated, and capable of all the phases from obtuse to pointed; it is pure white, and has not the byssal groove of the tribe, which is a considerable variation of structure, and the teeth are not so slender, long, or parallel, more resembling those of *Venus*, from which this animal scarcely differs. The mantle posteriorly forms the siphons, which are soldered together three parts of their length, becoming separated for the remaining portion; the colour is delicate pale lemon, tinged with red-brown at the bifurcation; they are of the same size, the branchial being truncate at the extremity, and clothed with fourteen pointed cirrhi, whereof seven are rather the largest, marked at their bases on each side with a patch of bistre, the interstitial ones are white; the anal tube curves upwards as in its congeners, and does not appear truncate, in consequence of its edges being a little inflexed; it has sixteen short white cirrhi at the orifice, which has also around it a dirty red-brown fine line; the tubes, when fully extended, are less long than in the two preceding species; they do not, as in *Venus*, measure more than half the transverse measure of the shell. The pair of subcircular branchiæ on each side are pale drab, hung very obliquely; the under ones are at least double the size of the upper, and strongly marked by the transverse vessels of the circulation; the palpi are subtriangular, short, and well striated. The liver appears scanty and of a pale green.

This species inhabits the coralline zone at Exmouth, but is rarely taken alive; dead shells in good condition are frequent. We almost think that this species and its variety the *P. Sarniensis* should, from the absence of the byssal groove and the greater divergence of the teeth from the type, be transferred to the *Veneres*. The *P. aurea* has not occurred alive; is it distinct from the present species? the teeth of the two are of similar character, and if it is without the byssal groove, it would appear that it ought to accompany the *P. virginea* to the typical *Veneres*.

DONACIDÆ.

If this family had only consisted of the genus *Donax*, we would have united it to the *Tellinidæ*; but as it is conjoined to *Ervilia*, a more aberrant genus, we adopt it. The siphons appear to be shorter than in the *Tellinidæ*, and their cilia of a more complicated structure; the dentition is also less simple. There are only three undoubted British species, two in *Donax*, *D. anatinus* and *D. politus* — the *D. trunculus* is probably exotic—and one in *Ervilia*, the *E. castanea*.

DONAX, Linnæus.

D. ANATINUS, Lamarck.

D. anatinus, Brit. Moll. i. p. 332, pl. 21. f. 4, 5, 6; (animal) pl. K. f. 7.

Animal elongated, of a purplish-red or yellow; mantle open on the ventral range, with double margins, the one short, with sinuated or scalloped edges; the other and outer is clothed with three rows of fringe, the two inner being two sizes of moniliform white beads; the outermost or third row has short, close-set, fine filaments of similar colour, altogether presenting a very elegant appearance. The siphons are of the same length, and, when fully exserted, are not more than half an inch; they do not put on a cylindrical aspect, but appear laterally compressed; they are separate from the bases, and taper gradually to their terminations, which are bordered with very pale orange colour; the anal siphon is rather the smallest, and furnished with about six white cirrhi; the branchial has 8–10 longer ones, which are fimbriated at the sides, besides plain ones interspersed; when the cirrhi are withdrawn, the terminations of the tubes have a truncate and naked aspect; a good lens must be used to see their minute developments. The foot is yellow or orange, especially when the animal has been immersed in hot water, very large, flat, bevelled to a sharp edge and lanceolate point when fully

extended, but at rest, or half exserted, it is puckered and transversely ridged. There are a pair of light brown suboval branchiæ on each side, the upper ones being less and shorter than the lower, hung more obliquely, and scarcely visibly pectinated on either side; the palpi are rather long, triangular, pale yellow, smooth exteriorly, and well striated on the inner areas. The liver is a pale brown-green. The stylet and attritor are well developed. The ovarium varies in colour from white or yellow to bright red; it is anterior and under the liver. The rectum, after a convolution or two, passes through the dorsal region, embraced by the heart and white linear auricles, to the anal tube.

These beautiful shells are plentifully found with the live animal at Exmouth, and in the littoral and laminarian zones of the Warren sands, between that place and Dawlish.

We have not met with the *D. politus* alive or dead on the western coasts;—we refer to it—

D. POLITUS, Poli.

D. politus, Brit. Moll. i. p. 336, pl. 21. f. 7.
D. complanatus, Auctorum.

ERVILIA, Turton.

E. CASTANEA, Montagu.

E. castanea, Brit. Moll. i. p. 341, pl. 31. f. 5, 6.

All that can be said of this animal is, that it has not been observed, though we believe it has been taken alive on the Irish coasts by Mr. Barlee, who favoured us with a small fresh specimen. We trust that indefatigable naturalist will, in an excursion he contemplates again to explore the sea-beds of the Emerald Isle, make us acquainted with the external organs of this interesting species.

TELLINIDÆ.

The British *Tellinidæ* are distributed in four genera, *Tellina*, *Scrobicularia*, *Syndosmya*, and *Lucinopsis*; their

shells are, with few exceptions, thin, delicate, of small size, generally having the transverse measure double that of the vertical; the siphons of the animal are slender, usually separated to their bases, nearly as proportionately long as in the *Pholades*, and sparingly cirrhated at their terminations. We consider the posterior flexure of the shell of little distinctive value: all bivalves have it more or less. The most curious incident attached to some of the Tellinidan genera is, the amalgamation of each pair of branchiæ into one large lamina, the upper plate being as it were thrown back and permanently fixed to the dorsal range, as in the *Anatinæ*—a community of structure showing a close alliance between the two families. The genera and species of this group exhibit a greater departure from what are considered the typical points of configuration, than in most others; for example, the external and internal ligament and cartilage march together, as well as the double and single branchiæ; but, notwithstanding the discrepancies of structure, these aberrant genera and species have so much of the family character that they cannot well be placed elsewhere. It may hereafter be necessary to recast the *Tellinidæ*, and constitute some new families and genera; for the present, we shall distribute the different groups into sections embracing their aberrations and peculiarities in respect to the typical configuration, but we still hope to supply some useful rectifications.

The animals of *Tellina* and *Psammobia* are all but identical; a rigorous examination of both does not allow us to state an essential difference either in the internal or external organs; their shells also scarcely vary; the posterior flexure in *Psammobia* is almost as apparent as in *Tellina*. We think the genus might have been dispensed with; it is probably retained by authors because it forms a break in a long list, if the exotics are included; but that is not a sound reason for constituting two genera without a difference. We think that an essential service is done to science in relieving it of an artificial genus; therefore, in our method, *Psammobia* is merged in *Tellina*, which forms the first or typical section. As to the supposed difference in the lateral dentition of *Tellina* and *Psammobia*,

it is of little value, if it even existed, compared with the overwhelming similitude of the entire soft parts, habitudes and habitats of the animals; and we may observe, that in the so-called *Psammobia*, distinct lateral teeth are often present as well as absent; the same may be said of *Tellina*, but in both there are almost always obsolete traces of such laminæ.

The next section is a small tribe, which, with the external ligament and ordinary dentition of the *Tellinæ*, have only one large amalgamated branchial lamina on each side. *Lucinopsis* next follows, which we have shown to be nearly a strict *Tellina*. And lastly, *Syndosmya* and *Scrobicularia*, furnished with a ligament, that is, both external and internal, besides a spoon-shaped cavity for an internal cartilage, complete the Tellinidan category; these may hereafter constitute two distinct families, as the former has double branchiæ and the latter only one large lamina, as in the 2nd section, but cannot be placed in it on account of the very different hinge. These are the most aberrant of the *Tellinidæ*, and immediately connect this group with the *Anatinidæ*.

The genus *Diodonta* of Deshayes has been introduced into the British list to receive the *Tellina fragilis* of Linnæus and authors. It seems a very useless and artificial one, based on the teeth, and has no new characteristic that differs from *Tellina*—at least we can discover none. We dispense with the genus in its present form, and deposit its only species in the 2nd section of this family.

TELLINA, Linnæus.

Section I. *The typical species.*

T. DONACINA, Linnæus.

T. donacina, Brit. Moll. i. p. 292, pl. 20. f. 3, 4; (animal) pl. K. f. 4.
T. pygmæa, Brit. Moll. i. p. 295, pl. 19. f. 6, 7.

Animal oblong, compressed; mantle largely open, not fringed, but finely dentated. Siphonal tubes long, separate from their bases, plain and simple. Foot pure white, flat, broad, long, and lanceolate. On each side of the body there are a pair of pale brown suboval branchiæ, nearly of the same

size, smooth on the outer surfaces, and on the inner striated with about thirty of the delicate vessels of the branchial circulation; the corresponding pairs of subtriangular palpi are also pale brown, smooth on the outside, except showing a longitudinal furrow, and pectinated within.

These beautiful shells are frequently taken alive in the coralline zone at Exmouth. This animal may be placed, *par excellence*, at the head of the typical species.

T. CRASSA, Montagu.

T. crassa, Brit. Moll. i. p. 288, pl. 20. f. 1, 2.

Animal suborbicular, lentiform; the general ground colour is pale drab; mantle quite open, double-edged, finely, closely and conspicuously fringed, produced posteriorly into two long rather slender siphons, separate from their bases, the branchial quite plain at its termination; the upper or anal one, which is apparently rather the largest in diameter, and capable of great inflation, has six triangular points at the orifice; their ground colour is marked with two or three intenser whitish longitudinal lines. I am unable to state how far the tubes can be extended, as the animal was sent to Bath in 1851, wrapped in moist sea-weed, accompanied by bottles of sea-water, and had become partially collapsed; but I should think, judging from other *Tellinæ*, that in the specimen examined they would, when fully exserted, be at least 2 inches long. The shell was the largest I had ever seen, measuring transversely $2\frac{1}{2}$, and vertically $2\frac{1}{8}$ inches. The foot is the usual large, spatulate, thick, muscular, linguiform appendage of the *Tellinæ*, perfectly simple, without a trace of a groove in the heel. The pair of branchiæ on each side are subcircular, of very thin texture, the lower of great extent, the upper not half the depth of its larger fellow; both coarsely but not distinctly pectinated. The palpi, a pair on each side, are narrow, slender, pointed, of a very elongated triangular shape, quite smooth externally, but well striated within. The liver is anterior, of a dark brownish-green; the stomach contained the usual tricuspid membrane, or attritor, and the crystalline stylet of large size. The heart, auricles, nervous ganglia, with

the stomach and intestine, exhibited no peculiarity. The large posterior dorsal mucous gland was well developed, the colour being a moderately dark brown: this gland crosses the dorsal line near the posterior adductor, and perhaps is a receptacle for the pigments of the mantle.

This species inhabits the coralline zone at Exmouth, but is rarely taken alive of good size.

T. FERROËNSIS, Chemnitz et nobis.

Psammobia ferroënsis, Brit. Moll. i. p. 274, pl. 19. f. 3.

Animal elongated, compressed, white or of the palest brown; mantle open, with the margin clothed with a short white fringe, or rather fine dentations. The siphonal apparatus consists of the usual slender separated tubes, the branchial being rather the longest and largest, having six plain cirrhi at the orifice; when not fully extended it appears finely corrugated, and has two longitudinal bars on the surface; the anal siphon curves upwards, the orifice being destitute of cirrhi. The foot is very large, flat, long, bevelled to a sharp edge, and lanceolate. There are a pair of branchiæ and a pair of palpi on each side; the under laminæ are by far the largest, long, deep, and subquadrangular; the upper ones are not above half the size, of suboval shape, and have a lanceolate termination, hanging on the posterior portion of the large ones; they are all visibly striated on both surfaces; the palpi are long, subtriangular, and very well pectinated. The liver is pale green, conjoined with the pale yellow ovarium, which in July is full of ova in all states of development.

This elegant and variously coloured species as to the shell, is frequently taken in the dredge in the coral zone in a living state.

T. TELLINELLA, nobis.

Psammobia tellinella, Brit. Moll. i. p. 277, pl. 19. f. 4; and (animal) pl. K. f. 1.
P. florida, Turton.

Animal elongated, compressed, pure white; mantle open, dentated ventrally, and fringed posteriorly from the beaks to

the tubes. The siphons are moderately long, disunited, tapering and divergent; the anal one is the longest and most slender, curving upwards with exceedingly minute cirrhi at the extremity, of frosted white, and eight intenser longitudinal fine lines running from base to point; the branchial siphon is also frosted white, having six short cirrhi at the orifice, and intermediate shorter ones. There are a pair of pale brown suboval branchiæ, which hang obliquely; the upper very small, lapping on the much larger lower ones almost vertically; they are on both sides coarsely striated, the larger by only eight vessels of the circulation, separated from each other by as many fine lines. The pairs of palpi are rather long, subtriangular, pointed, pale brown, smooth outwardly, and within coarsely pectinated transversely, not having the furrow as in those of *T. donacina*. Foot flat, sharp-edged, slightly geniculated, linguiform, lanceolate at the point and pure white.

These animals are dredged in abundance at Exmouth, in a six-mile offing.

The following species have not been met with alive.

T. INCARNATA, Linnæus.
T. incarnata, Brit. Moll. i. p. 298, pl. 20. f. 5.

T. BALAUSTINA, Linnæus.
T. balaustina, Brit. Moll. i. p. 290, pl. 21. f. 2.

T. FABULA, Gronovius.
T. fabula, Brit. Moll. i. p. 302, pl. 19. f. 9.

T. PROXIMA, ? Brown.
T. proxima, Brit. Moll. i. p. 307, pl. 21. f. 1.

T. BRIMACULATA, Linnæus.
T. brimaculata, Brit. Moll. i. p. 309.

T. VESPERTINA, Chemnitz.
Psammobia vespertina, Brit. Moll. i. p. 271, pl. 19. f. 1, 2.

T. COSTULATA, Auctorum et nobis.
Psammobia costulata, Brit. Moll. i. p. 279, pl. 19. f. 5.

We are not certain, though we believe most of the above belong to this section; but we have doubts on the *T. fabula*, as the authors of the 'British Mollusca' observe that its

animal is like that of *T. tenuis*, which has only a single amalgamated branchial lamina on each side, and belongs to our second section; in that case, the *T. fabula* must march with it. But this point may easily be set at rest, as the species is common, though not in my district. The *T. proxima* is exotic or fossil. The *T. bimaculata* is exotic.

The *T. balaustina* of British origin has much similarity to specimens of *T. crassa* of the same size; the hinge, teeth, cicatrices, and pink radiating pencils are identical; the chief difference is the greater tumidity and tenuity of the valves, and the absence of the short vertical lines between the striæ of increment.

Section II. *Animal with a single branchia on each side.*

T. TENUIS, Da Costa.

T. tenuis, Brit. Moll. i. p. 300, pl. 19. f. 8; and (animal) pl. K. f. 3.

Animal very flat; mantle sufficiently open in the ventral range, finely fringed, produced posteriorly into two white siphons, separated from their bases, of about equal length and diameter; both of them are often exserted beyond the length of the shell; the anal is usually the longest, and curves upwards; but these circumstances depend on the will of the animal. There is only one very large pale brown, excessively membranous, subtriangular branchia, on each side, with the finest pectinations, fixed under the posterior dorsal range, where its point becomes united with that of the one on the other side, exactly as in *T. solidula*, but its margin is not fixed to the body so decidedly; it is more lax, and can be elevated by a camel's-hair brush, and is connected at the anterior angle by a branchial vein, with a pair on each side of large triangular palpi, but not so much out of size as in *T. solidula* and *Scrobicularia piperata*; they are pectinated on both sides, but more so on the inner surfaces; the colour is a darkish cloud hue, mixed with paler lines, giving them a mottled aspect; they are broad at the bases, not very long or pointed. The foot is large, broad, compressed, tongue-shaped, not very pointed, and geniculated. The liver is dark green;

the ovary anterior, running to the lower part of the body, is at this season (July) full of white ova in various stages of maturation. The stylet and stomachal attritor are present; indeed we believe that they may be found in every bivalve.

These notes, with those on *T. solidula*, suggest the query,—ought not the two, and any other of similar branchial structure, to be removed from the typical *Tellinæ*, to a distinct Tellinidan genus? The singular character of the single compound branchial plate on each side, their oblique, almost vertical position, together with the form, disposition and enormous size of the two pair of triangular palpi, so entirely different in the *Tellinæ* of the first section, would appear to sanction such a procedure.

T. SOLIDULA, Pulteney.

T. solidula, Brit. Moll. i. p. 304, pl. 20. f. 6.

Animal suboval, thick; mantle of strong and firm texture, tumid at the margins, which have a fine short lead-coloured fringe, closed posteriorly, and forming two very long hyaline siphons; the anal one turns upward, and is often exserted to almost twice the length of the shell, plain at the orifice; the branchial is usually less extended, and has 4–6 very minute dentations at the aperture; in the protrusion of the tubes the animal is very capricious, often exserting the branchial far beyond the anal one and *vice versâ*, which has led authors into descriptive mistakes. The siphons are disunited from their bases. The foot is white, very large, thick and fleshy, of a lanceolate shape, but not very long and pointed, geniculated, and without byssal groove. The branchial apparatus is curious, and a departure from the *Tellina* type; it consists of a *single* rather elongated branchial plate, on each side, situated towards the posterior half of the animal; it is fixed to the dorsal range by its base running obliquely, indeed almost vertically from the dorsal to the ventral range, becoming joined to its fellow under the posterior and smaller part of the body, by a permanent membrane. The whole area of the plate is well fixed, the two sides being scarcely free at the

edges; the branchial artery divides it nearly in two equal parts; it may be considered as a pair of laminæ, which, instead of being folded or falling on each other, as in the ordinary bivalves, are thrown open and permanently fixed to the posterior area of the body. The colour is brownish drab, with a yellow or fawn-coloured patch in two or three places; anteally there are on each side two enormous triangular, broad at their bases, pointed palpi, smooth without and well striated within; they are so large as nearly to have the aspect of small pairs of branchiæ; they are in connection by one of their angles with the branchial plate, and with each other by labia around the mouth. The colour is drab, aspersed with very minute sand-like, pale red-brown points. The liver is brownish-green and united anteriorly with the ovarium. The elastic stylet and corneous stomach attritor, called by most authors the tricuspid membrane, is particularly firm and conspicuous in this species. It thus appears that our present animal differs greatly from the typical *Tellinæ*, in the branchial plate and character of the palpi, and thick obtuse foot.

This species has also a rather close alliance with *Scrobicularia piperata*, which has like it only one compound branchia on each side.

T. FRAGILIS, Linn. et Auctorum.

T. fragilis, Philippi, Moll. Siciliæ.

Diodonta fragilis, Brit. Moll. i. p. 284, pl. 21. f. 3; (animal) pl. K. f. 2.

We are not aware that any British author has observed this species. The following is a translation from M. Philippi's very insufficient notice of it, in the 'Enum. Moll. Siciliæ,' vol. i. p. 28: "Animal with two siphons, the lower or branchial being nearly double the length of the shell, the upper scarcely so long as the shell; without cirrhi at the orifices; the foot is small, oblong, lanceolate, with very large oval palpi."

We can say nothing of M. Deshayes' description of the animal organs. In the 'British Mollusca' we have some further particulars: Mantle fimbriated at the edge; siphons of unequal lengths, separated from the bases, and, contrary to

Philippi, stated to be cirrhated at their apertures; foot not very large, without byssal groove. Nothing is said in either account of the branchiæ, and Philippi only observes that the animal has very "large oval palpi"; from which we hazard an opinion that it may belong to our second section, in which there is only one compound branchial lamina, and excessively large palpi on each side of the body. In these extracts we have a strict description of a true Tellinidan, of either the first or second section. The teeth also are those of a *Tellina*, either without or with obsolete laterals. *Diodonta* therefore is only synonymous with a *Tellina* of one or other of the sections. But if, from the very considerable variation of animal structure in the two divisions, it should be thought advisable to constitute a distinct genus for the second section, with the single compound branchia on each side, and *Diodonta* should realize our conjectures as to a similar form of the organs, it would have priority over any other generic term, and in that case would receive as congeners *T. tenuis*, *T. solidula*, and perhaps *T. fabula*.

These are the reasons that have induced us provisionally to deposit the *T. fragilis* in the second section, until we have further information on the required points. And we invite naturalists who are in the vicinity of this interesting species publicly to record their notes.

LUCINOPSIS, Forbes and Hanley.

The *Venus undata* of the older conchological authorities, which has been justly separated from *Venus* by more recent writers under various appellations, and particularly by the learned authors of the 'British Mollusca' under the title of *Lucinopsis undata*, has given rise to much difference of opinion amongst malacologists in regard to its natural position. Though the shell of this species, anomalous in several points, has long been known, the aggregation of the curious characters of its animal has never been sufficiently described, from the difficulty of procuring it alive of large size. The quotation from my manuscript in the 'British Mollusca' is the result of

the examination of very small specimens, not more than $\frac{3}{8}$ths of an inch diameter, though it is as correct and full as could well be expected from such materials; but the receipt from Exmouth of adult lively examples of $1\frac{1}{2}$ inch diameter, has enabled me to review and add to it several unrecorded features, which I think will interest malacologists, and show that this peculiar genus has scarcely yet received its precise natural allocation; and many important circumstances will be developed, which may assist to determine the proper station of some other bivalve molluscan groups, by the concatenation of characters exhibited by this animal, illustrative of its connection with them.

L. UNDATA, Pennant.

L. undata, Brit. Moll. i. p. 435, pl. 28. f. 1, 2; (animal) pl. M. f. 2.
Venus undata, Auctorum.

Animal inhabiting a shell of thin and fragile texture, like many of the *Tellinæ*, irregularly subrotund, and not exhibiting the decided lenticular form of its shell; the general colour is pale pinkish-drab, which, when the animal has been killed by hot water, often changes to the various hues of orange, red, and brown: this remark is of some importance as regards correct description, for under similar circumstances this condition prevails more or less in all the testaceous Mollusca, and particularly in the bivalves. The mantle has its edges sinuated or furbelowed, in some examples irregularly jagged, but not serrated; the ventral aperture is very contracted, only affording space for the issue of a moderately sized foot, in consequence of the basal position and very large size of the posterior adductor; and though the anterior one is nearer the dorsal region, it also, from the length, contributes to the smallness of the pedal aperture; the mantle is produced posteriorly into two very long pale orange siphons, divergent and separated to their bases; the branchial one is the smallest and longest, being in adult examples in full extension $1\frac{1}{2}$ inch long, and having the extremity margined by a circle of very short, minute dark lines, blotches or dots, with 16–20 white cirrhi of irregular sizes and lengths; the anal siphon is of rather

larger diameter, and when protruded is barely an inch in length; its extremity is furnished with 12–15 white, short cirrhi, of more uniform length than in the branchial; it has not the dark terminal margin of points: the usual hyaline valve was not observed, but it probably exists.

This siphonal apparatus has the entire aspect of that of the typical *Tellinidæ*; but its position when exserted is singular, being very little posterior to the centre of the ventral range, instead of being, as is more usual, protruded from a posterior angle somewhat more basal than a right one to a vertical line drawn from the beaks to the ventral centre; this nearly central basal site is occasioned by the great size and low position of the posterior adductor, which necessarily compels the issue I have described.

The foot is white, not large, flat, bevelled, pointed, very little geniculated, without a byssal groove, scarcely differing from the *Tellinæ* and some of the *Veneres*; it also, from the causes assigned to the siphons, has a more basal position than usual when protruded, with a very limited anterior action, from which it may be inferred that the motive power is confined to the turning from side to side and on its centre. The branchiæ are subcircular, the upper plates being much less than the lower, half lapping on them, pale drab, with moderately fine but not very distinct pectinations; the pair of palpi on each side are fleshy, rather long, triangular, pointed, strongly pectinated on the outsides, smooth within, and connected with each other around the mouth; they are also light drab. The body is pale pink, small and subglobular, having the foot fixed to its centre. The liver is grass-green. I have already alluded to the texture of the shell, but it is necessary to add, that in the right valve there are two laminar primary teeth, and in the left two similar ones, with a strong double tooth between them: there are no laterals.

It would then appear, that the texture of the shell, the two laminar teeth in the right valve, and the exact similitude to the typical *Tellinæ*, of the very long, slender, divergent siphonal apparatus having each tube completely separated to the base, ally this animal by many degrees nearer to the *Tellinidæ* than

to the *Veneridæ*, as none of the genera of the latter family have any resemblance to this siphonal condition; still it cannot be lost sight of, that the three primary teeth in the left valve, which appear in no tribe but in that of the *Veneres*, give it a decided connecting link with them.

As to the alliance of *Lucinopsis* with *Lucina*, it is not very near, and principally consists in its lenticular shape, which, however, is that of many of the *Veneres*, so that a less significant appellation might have been preferable. I must likewise observe, that there are some differences of shape and position from either the *Tellinæ* or *Veneres* in the adductor cicatrices of *Lucinopsis*, which have a slight approach to the *Lucinæ*; in other respects there is little in common between the two, there being no siphonal apparatus, and a very peculiar foot in *Lucina*.

These remarks may induce malacologists to take into consideration, that, the *Tellinidæ* and *Veneridæ* being so closely allied by the intervention of *Lucinopsis*, it would be desirable to remove *Mactra* into the vicinity of *Cyprina*, to precede it and follow *Cardium*, in which case the line would march thus: —*Cardiadæ*, *Mactridæ*, *Cyprinidæ*, the *Veneridæ*, then the *Donacidæ*, the *Tellinidæ*, and their genera, &c.; and thus, by relieving the *Tellinidæ* and *Veneridæ* of the intermediacy of the *Mactræ*, perhaps a greater approach to a natural position would be obtained.

The peculiar characters of the shell of *Mactra* create a difficulty with respect to natural order, as it has many features of the *Myadæ* and *Anatinidæ*; but the open mantle of the animal will not allow it to be so near a neighbour to them as to follow the *Tellinidæ*; neither can it remain between the latter family and the *Veneres*, the union of which, I think, is more naturally effected by *Lucinopsis*, notwithstanding the anomalies that exist in that genus. The siphons of *Mactra* are altogether different from those of the *Tellinæ*; their tubes are more congruous with the *Veneridæ*, so that it might have been placed immediately after the typical *Veneres* if the *Cyprinidæ* had not intervened, which, however, cannot be severed from them, merely because their siphons are so short as scarcely to pro-

duce a scar;—therefore it would appear difficult to fix *Mactra* otherwise than to follow the *Cardiadæ*, and come into line between them and the *Cyprinidæ*.

SYNDOSMYA, Recluz.

S. ALBA, Wood.

S. alba, Brit. Moll. i. p. 316, pl. 17. f. 12, 13, 14.
Mactra Boysii, Montagu.

Animal suboval, compressed, very pale bluish-white; mantle open, with the margin dentated. The branchial and anal siphons are separate from the bases, very elastic both laterally and longitudinally; when in full action cylindrical, and ordinarily as long as the shell, often much longer. The animal can inflate them to three times their usual diameter; they are light brown, the effect of an epidermis, the ground colour being white; when half exserted they are strongly corrugated. The branchial siphon is truncate and simple at the orifice; the anal has the usual tubular hyaline valve, and is otherwise plain. The branchiæ are a pair on each side, suboval, pale brown, symmetrical, hanging obliquely from the dorsal range; in our small specimens we could not satisfy ourselves on the character of the palpi, but think the large branchiæ are carried round the mouth without a solution of continuity, as in the *Arcadæ*; they are well pectinated within and smooth without. The foot is large in proportion to the animal, muscular, slightly angulated at the heel, lanceolate, white, without a byssal groove. The ventral portion of the body is marked with intensely white spots. The liver is green, and the ovarium of a bluish-white colour, full of ova in August.

This is an aberrant genus of the *Tellinidæ*; in the shell and organs of the animal it presents singular departures from what we have been accustomed to consider the typical points of their organic structure. This genus requires a careful examination of its species, which may eventually, in conjunction with *Scrobicularia*, lead to the formation of a family intermediate to the *Tellinidæ* and *Anatinidæ*. At one time we

thought the *Scrobicularia piperata* should be amalgamated with the *Syndosmyæ*, but a careful review of the two animals in 1849 has convinced us that there are considerable organic variations, particularly in the arrangement of the palpi and in the size of the branchial laminæ, which in *Syndosmya alba* are of equal dimensions, but in *S. piperata* completely discordant; again, the habitats of the two are very different, the "*piperata*" being imbedded for a foot or more in the pure muddy deposits of the estuaries, whilst the *Syndosmyæ* live in the mud of the sea-beds of the South Devon coasts, two or three miles from shore, and are taken alive at Exmouth, Dawlish, and Babbacombe Bays.

Exmouth, 3rd August, 1850.

An examination this day of large specimens, shows that there are a pair on each side of nearly equal suboval branchiæ, and a *single* large palpum, broad at the base, triangular, not sharp-pointed nor very long, and slightly pectinated, divided in the centre by a depressed line, probably the artery; this gives the aspect of two narrow palpi. This plate is connected at its angular point with its fellow on the other side.

S. PRISMATICA, Mont. et Auct.

S. prismatica, Brit. Moll. i. p. 321, pl. 17. f. 15.

Animal compressed, white; mantle open throughout the ventral range, finely fringed, forming a siphonal apparatus of two long, slender, separated tubes, nearly of the same length; both have 5–7 short cirrhal points at the orifices, which are sometimes obsolete; the anal tube is of the lesser diameter, but the animal often greatly inflates it, particularly the terminus, into a bulbous or club shape, and then instantly attenuates it to a filiform state as fine as a needle. The tubes, when not withdrawn, are corrugated, and covered with a very thin pale brown epidermis. There are, on each side, a pair of suboval branchial laminæ, of equal size, well pectinated, and also *a pair*—not a single palpum, as in *S. alba*, if we are not in error with respect to that species,—of thin, short, broad, triangular pointed palpi, smooth without and striated

within. The foot is long, broad, flat, large, white, pointed, and geniculated, as in *Tellina*; indeed, the animal is closely allied to that genus; the greatest difference is in the shell, which, with the outward ligament of the *Tellinæ*, has also a small internal cartilage fixed in an oblique cavity. The liver is dark green, placed at the summit of the dorsal line. We extracted the crystalline stylet and attritor, called by authors the tricuspid membrane.

It inhabits, sparingly, the coralline zone at Exmouth.

The two following species have not occurred:—

S. TENUIS, Montagu.

S. tenuis, Brit. Moll. i. p. 323, pl. 17. f. 11.

S. INTERMEDIA? Thompson.

S. intermedia? Brit. Moll. i. p. 319, pl. 17. f. 9, 10; (animal) pl. K. f. 5.

We very much think that the *S. intermedia* is nothing more than a variety of *S. prismatica*, being the result of climate.

SCROBICULARIA, Schumacher.

S. PIPERATA, Gmelin et Philippi.

S. piperata, Brit. Moll. i. p. 326, pl. 15. f. 5; (animal) pl. K. f. 6.
Mactra compressa, nonnull.

Animal suboval, compressed, pale yellowish-brown; mantle open, with a fringe only visible by the aid of a good lens; the siphons are nearly as long as the shell, separate from their bases, of the same length, subcylindrical, tapering to the extremities, which are truncate, without cirrhi, of a pale dirty-brown, the effect of a fine epidermis. There is, on each side, a *single*, subangular, pale yellow branchia, running obliquely, I may say almost vertically, from the dorsal to the ventral range, very finely pectinated on the outside, but more intensely within; the *two* palpi, on each side, are large, thin, flat, very long, triangular, broad above, pointed at their terminations; they present the same characters as to colour and pectination as the branchiæ.

This is strictly a littoral species, inhabiting the quiet muddy

inlets. At Exmouth they are of very large size, often more than 2 inches transverse measure, of a fine ochraceous colour; the fishermen call them "mud hens."

ANATINIDÆ.

This family, according to our views, contains only a single genus, *Anatina*, long used by authors for this group, but which, without good reason, has been dismembered and split into the genera *Lyonsia*, *Osteodesma*, *Thracia*, *Cochleodesma*, *Periploma*, *Neæra*, and *Poromya*. We have examined more specimens of the four first so-called genera, than are sufficient to entitle us to say, that the animals of all of them are identical as to essentials of the soft parts, and there is also, in all, the great conchological characteristic,—the accessorial testaceous ossicle. I believe that the generic term *Anatina* has the priority, but it is a matter of indifference if either of the other appellations are applied, so that we have not eight genera for the same animal. All this confusion has arisen from M. Deshayes having, in his comments on Lamarck, shown that he had not observed the animals, by having collected and adopted the artificial genera of authors; what is more remarkable, this eminent zoologist admits that he did not know whether all the species of the tribe were provided with the ossicle, and instances as doubtful the *A. myalis* of Lamarck, our *A. declivis*. We have not only seen the testaceous accessory of this species, but of every other British *Anatina*; that appendage is the invariable distinguishing character of this family, which is the only one that is furnished with this curious cardinal internal distinct testaceous addition which clasps the valves, or is imbedded in the cartilage of the apophysary cavity; its shape is various, usually a semilunar minute cord, sometimes subtrigonal; it is exceedingly brittle, in appearance at least, except in *A. norvegica*. We scarcely know its use in the animal œconomy, but presume it is to fortify the hinge, by acting like the check-tape of a trunk to prevent too great an opening and strain on it.

We have named *Periploma*, but are not aware that any British species has been consigned to it: as to *Neæra* and *Poromya*, newly constituted genera, our reasons for introducing them to this family will appear hereafter.

The *Anatinidæ* have some connections with *Corbula* and *Pandora*, but the greater length, separation, and slenderness of the siphons still remind us of the vicinity of the *Tellinidæ*. A malacological character of high importance is attached to this group, which we consider decisive of the propriety of merging in *Anatina* the *Lyonsia* or *Osteodesma*, and the *Thracia* and *Cochleodesma* of authors, which is, that all the British members of these genera have only a single branchial lamina on each side. Two or three of the *Tellinæ* have a similar structure, but they are mere exceptions to a rule, and evidence the point of passage between the *Anatinæ* and *Tellinæ*; but in *Anatina* it is, we believe, the rule; though we cannot positively assert that it applies to *Neæra* and *Poromya*, yet there is little doubt that it does; but as the species are not uncommon in Scotland, we hope that the Northmen will enlighten us on this point.

ANATINA, Lamarck.

Thracia, Recentiorum.

A. PHASEOLINA, Lamarck et nobis.

Thracia phaseolina, Brit. Moll. i. p. 221, pl. 17. f. 5, 6; (animal) pl. H. f. 4.

Animal subovally elongated, moderately thick, pale brown; mantle closed, except a fissure quite anteriorly for the passage of a compressed, not very long, spatulate foot, with a rounded extremity, and posteriorly, for the issue of two moderately long siphons, which are separate nearly their length, but the animal always carries them in a divergent posture at the extremities; both are furnished at the orifice with a few minute rays; the tubes are capable of great inflation. There is only *one* large, suboval, pale brown branchial lamina on each side, smooth within and pectinated without; each lamina

is divided in two parts by a strong deep oblique furrow by which it is attached, and may be that in which the artery or vein runs; the lower part of each plate is free, and can be raised as far as the furrow; we may say that the branchiæ, instead of being doubled, lay open and present in each the same area in one large plate, as if they were in two. The furrow gives the appearance of two branchiæ; but it must not be supposed that the upper portion nearest to the dorsal line has been displaced or thrown back by accident; it is securely fixed thereto by its membrane, and thus forms a single open plate. This branchial arrangement is confined to very few families; the *Anatinæ* constitute its head-quarters; all the species probably have it; in this we have only detected one short triangular palpum, but there may be two, or the rudiment of a second; in *A. norvegica*, of the same branchial form, there are *two* complete palpi. The foot is bluish-white, not lanceolate, in the animal now described; but in our notes, written many years ago, it was stated to be lanceolate, and it may be so: this apparent discrepancy perhaps originates from the present animal having had a part of the valve lacerated, thus preventing the full exsertion of the foot, and giving it a blunt and rather clavate extremity. We propose this species as the type.

Live and dead shells are frequently dredged in the coral zone at Exmouth, the latter with rarely the ossicle; in the live ones great care must be taken not to remove it with the animal.

This species, termed *Mya pubescens* by the older authors, was long considered the young of Pennant's and our *A. declivis*, until, by a suite of specimens dredged by us many years since, we demonstrated that it had true specific pretensions.

A. INTERMEDIA, nobis.

A. villosiuscula, Macgillivray.
Thracia villosiuscula, Brit. Moll. i. p. 224, pl. 17. f. 4, 7.

Having examined numerous live specimens of this species, it would be a mere repetition of the notes of the type to say

more than that it is scarcely distinguishable from it malacologically. The shell is rather more convex, the posterior end shorter, more arcuated and scabrous, not quite so broad, and the ossicle somewhat more wiry than in *A. phaseolina*: the two when adult are about the same size.

I am the original discoverer, more than thirty years ago, and named it specifically *intermedia*, by which appellation it was long known on the Devon coasts, and in private collections, but I neglected to substantiate my claim by publication. Agreeably to the 'British Mollusca,' i. p. 224, Mr. Macgillivray described and named it *Anatina villosiuscula*, in Jameson's Edinburgh Philosophical Journal, 1827. Of course by my *lâches* I lost my discovery; but it is strange that Professor Macgillivray, in his 'Mollusca' of *Scotland*, in 1844, passes over his own previous notes and my discovery without the slightest recognition. It is possible the learned Professor may have had reason to doubt the honour of paternity, and thus handsomely consigned it to the care of the "*vrai Amphitryon.*" Consequently, under this view, I feel that I am morally, if not strictly, entitled to take care of my own bairn.

A. NORVEGICA, Chemnitz et nobis.

Lyonsia norvegica, Brit. Moll. i. p. 214, pl. 8. f. 6–9; (animal) pl. H. f. 3.

Mya norvegica, Auctorum.

Animal elongated, rather thick, of a pale brown aspect, except the foot; the liver is grass-green. The mantle is closed, leaving only an opening for the foot close to the posterior end. The margin of the pedal aperture is strongly scalloped, marked between the dentations with black points, as well as on the sutural line of the mantle for some distance on both sides of it. The foot is pure white, flat, broad at the base, tapers to a point, and is cloven at the heel, from whence byssal filaments issue. The siphonal processes are two short tubes, which appear enclosed in one sheath, that has the margin finely dentated; each orifice is garnished with about eight white simple cirrhi and as many black equidistant points at their external edges; the surfaces of both tubes when ex-

serted are sprinkled with minute red-brown points; the anal siphon is conically pointed, and protrudes the usual hyaline tubular valve; the branchial is truncate. The branchiæ are narrow, elongated, pale brown, and composed of only one lamina, on each side, which have all the incidents of that organ in *A. phaseolina*, to which we refer; but there are two distinct palpi, that are long, narrow triangular, pointed, pectinated within, and less so on the outer surface, of a similar colour as the branchiæ. We believe that most of these animals emit byssal filaments. These notes show that this species is in close accordance with its congeners; the testaceous subtriangular ossicle of the hinge emphatically pronounces it a member of the *Anatinæ*. The lustrous aspect of the interior of the valves has been considered of greater importance than it deserves; that character may indicate an affinity with *Pandora*, but, as far as regards generic considerations, is of little value. Nothing can outweigh the characters of the ossicle and single compound branchial lamina on each side the body; these indelibly mark the position of the present species.

This very elegant object is often taken in the coral zone at Exmouth. In empty shells the ossicle is absent; but we have at certain seasons captured many live specimens. The sandy coat with which the shell is clothed for the protection of the animal must be removed before all its beauty can be seen.

A. CUSPIDATA, nobis.

A. brevirostris, Brown.
Tellina cuspidata, Olivi.
Neæra cuspidata, Brit. Moll. i. p. 195, pl. 7. f. 4, 5, 6; (animal) pl. G. f. 4, 5, 6, 7.
N. costellata, Brit. Moll. i. p. 199, pl. 7. f. 8, 9; (animal) pl. G. f. 8, 9.
N. abbreviata, Brit. Moll. i. p. 201, pl. 7. f. 7.

We have no hesitation in relieving the British list from the genus *Neæra*; indeed we have no choice, as its only species is a strict *Anatina* — the *Thracia* of the moderns — having the crescent-shaped, or in this case, the double paralleled sub-

circular ossicle clasping vertically the two valves. This is Hobson's choice; for we presume that all malacologists are aware that no other genus except *Anatina* is armed with this singular distinction. There can be no mistake, as we have in our cabinet the ossicles separately displayed, and they prove by their identity that the "*costellata*" and "*abbreviata*" are the scions of the type, the latter being the young, and the former a variety. Many bivalves of the *same species* differ much more in their varieties; for example, the strongly punctured, and the nearly smooth *Lepton convexum*. Brown in the first instance placed this genus and species properly as the *Anatina brevirostris*, but unfortunately, to truckle to the fashionable nomenclature of the day, he changed it to *Thracia brevirostra*; but it is probable Olivi's specific title has the priority.

For what is known of the animal we refer to the 'British Mollusca,' under the titles *Neæra cuspidata*, *N. costellata* and *N. abbreviata*. If the diligence of malacologists had been a little more awakened to the observation of the conspicuous ossicle, they might have spared themselves some trouble by depositing their articles in genera already constituted, and singularly appropriate.

This species is taken sufficiently abundant on the Scotch coasts.

A. GRANULATA, nobis.

Corbula? granulata, Nyst and Westendorf.
Poromya granulata, Brit. Moll. i. p. 204, pl. 9. f. 4, 5, 6.

This is the *Poromya* of authors. To prevent repetition we refer to our general remarks on the *Anatina cuspidata*. We are almost afraid, that in admitting this species as distinct from *Anatina convexa*, some error may be committed. We have most carefully examined the hinge of the two, and find it essentially the same; both have the ossicle and their posterior extremities bi-angulated; they have the same shagreen-like points or punctures in the test, increasing in intensity at the margins; the siphons have the similar short character, and are in like manner ornamented with cirrhi or filaments of different lengths; both present on each side the broad amal-

gamated single branchia, the invariable condition of all the *Anatinæ*; at least we judge so in respect of the present species from a perfect dried animal, which, when saturated with moisture, appeared to support this view; and as regards the *A. convexa*, though we have not seen it alive, we determine by the analogy of several that have been examined. The contour of the two is only slightly different in many young or dwarf examples of the "*convexa*." In saying this we do not mean to insist on identity. At any rate, enough surely has been stated to convince, that the two are absolutely congeneric, and, if not identical, they are all but so. For an account of the animal of this Scotch production we refer to the 'British Mollusca,' i. p. 204, and iv. p. 250, of the Appendix.

A. BIDENTATA, nobis.

Montacuta bidentata, Brit. Moll. ii. p. 75, pl. 18. f. 6 & 6 *a*.

We feel sufficiently confident to remove this species from the modern genus *Montacuta* to *Anatina*: the distinct concave subcircular ossicle, which we can show in specimens, and the bi-angulation of the siphonal extremity — the invariable characteristic of *Anatina* — left us no alternative; indeed our observations on *Lepton Clarkiæ* must have prepared malacologists for this removal. I allude to the mention of the ossicle, which is of such high authority as to require no remarks with respect to position. Contrary to most of the *Anatinæ*, the mantle of this animal is only closed posteally; but this exception shows the value we set on the preceding observation on the ossicle.

Animal inhabiting a white shell, smooth at the umbones, and often roughened at the margins with minute points, of $\frac{1}{8}$th of an inch transverse, and not quite $\frac{1}{10}$th vertical measure, with prominent pointed beaks, of oval shape anteally, and subangular posteally, which side is the shortest slope from the beaks; in the right valve, close on each side the ossicular and cartilage-pit, is a strong triangular, flattish, acutely pointed cardinal tooth; in the left valve the central pit is without cardinals, but there are two rather distant obsolete laterals.

The ground colour of the animal is hyaline white; the mantle is considerably extended beyond the margins of the shell, and is of azure hyaline, edged with brilliant silvery, close-set, symmetrical, blunt, short, but distinct dentations, which extend on both sides to near the beaks; consequently it is open from the anterior side, throughout the ventral range, to the sessile anal tube, which is scarcely visible, being within the margins of the shell, from which we saw ejected the elongated oval drab pellets: this is the only apparent siphonal orifice. The foot is very large, long, broad, subtriangular, hyaline, well suffused with flake-white points; it is usually protruded in the centre of the ventral range, and the animal frequently passes it from stem to stern; it is slightly geniculated and has a decided byssal groove.

The animal is lively, marches with rapidity, and in its course turns from side to side, sometimes resting the shell on the ventral range in an upright posture. The branchiæ and palpi, from their minuteness, escaped observation. It inhabits the coralline district at Exmouth, from which we have obtained many live examples.

A. FERRUGINOSA, nobis.

Montacuta ferruginosa, Brit. Moll. ii. p. 72, pl. 18. f. 5, 5 *a* & 5 *b*.
Mya ferruginosa, Montagu et Auctorum.

This species has not occurred to us alive, and up to 1849 all the information obtained from naturalists was, that the foot is large, the posterior tubes absent, that it has only a sessile orifice, and that the anterior end of the shell is the longer side. But since that date, in 1850, we have had the advantage of seeing Mr. Alder's paper on the *Montacuta ferruginosa* in the 'Annals of Natural History,' N. S. v. p. 210, pl. 6. f. B. We collect from the account, that the mantle of the animal is considerably produced anteally, and fringed for a large portion of its extent. A comparison of these points with our own notes on the *Anatina bidentata*, which authors style *Montacuta bidentata*, of which we have examined many live examples, shows the concordance of the two species; in both, the anteally produced and fringed mantle, the character of the foot, and

very similar hinge and dentition, have satisfied us of the family identity. Though, in our only specimen of the "*ferruginosa,*" the moveable ossicle is not present, probably in consequence of its being removed with the animal, still we are convinced that in perfect and fresh specimens, opened with great care, the ossicle will be found; the delicacy and fragility of this appendage are excessive, and though we have several of the *A. bidentata* in beautiful condition, ninety-nine out of a hundred cabinet examples will be found imperfect. Consequently being morally certain that the "*ferruginosa*" has the "shibboleth" of the *Anatinæ*, we feel justified in consigning it to that family, to range with its congener the *A. bidentata*.

We cannot concur with Mr. Alder in recognizing that his *Montacuta ferruginosa* exhibits a connective gradation with *Kellia*, *Lepton*, and *Galeomma*. We think these genera are well distinguished not only from it, but from each other, and are absolutely of different family types. We hope our new locations and explanatory remarks on these genera will satisfy naturalists that every discordance exists between *Lepton* and *Galeomma*, with the "*ferruginosa*"; the strict Arcadan foot of the first two has no community with the common linguiform pedal appendage of the latter, and all the other organs of one and the other are equally heterogeneous; and lastly, we state, that the differences between *Kellia* and the "*ferruginosa*" are equally decisive.

To prevent repetition, we only give short notes and references to the four remaining species of this family.

A. DECLIVIS, Pennant et nobis.

Thracia pubescens, Brit. Moll. i. p. 226, pl. 16. f. 2, 3.
Anatina myalis, Lamarck.

This is the largest British *Anatina*, being sometimes 3 inches transverse, and 2 of vertical measure. It differs in no essential point from its congeners except in size. It is a rare species, and it is difficult to obtain a suite of examples from half an inch upwards. It is taken in the coral zone at Exmouth, but rarely alive.

A. PRÆTENUIS, Pulteney et nobis.

Cochleodesma, Couthouy.
C. prætenue, Brit. Moll. i. p. 235, pl. 15. f. 4.

As the animal of this species varies in no material character from our type, we refer to our account of it in the 'British Mollusca,' which volumes we suppose to be in the hands of every cultivator of this branch of natural history. The specialties of the shell are not of moment in a generic point of view. The ossicle is large, and more apparent than usual.

A. DISTORTA, Montagu et nobis.

Thracia distorta, Brit. Moll. i. p. 231, pl. 17. f. 1, 2, 3, 8; (animal) pl. H. f. 5.

For an account of this animal, we refer to notes of ours in the 'British Mollusca.'
The ossicle is the most minute of the tribe.

A. CONVEXA, Wood et nobis.

Thracia convexa, Brit. Moll. i. p. 229, pl. 16. f. 1, 4.

We have not seen the animal of this species, but cannot doubt that it marches with its congeners. We have shells in our collection containing the usual arcuated ossicle. Small shells are frequently met with at Exmouth, but those of 2 inches transverse measure are very rare.

CORBULIDÆ.

This little group consists of three genera, *Corbula*, *Sphænia*, and *Pandora*; the first has only one established species; *Sphænia*, one; and the last, two; one of which is probably not indigenous. The *Corbulidæ*, by the closed mantle and short united siphons, are allied to the *Anatinidæ* and *Saxicavæ*.

CORBULA, Bruguière.

C. NUCLEUS, Lamarck.

C. nucleus, Brit. Moll. i. p. 181, pl. 9. f. 7–12; (animal) pl. G. f. 3.

Animal subtriangular, thick, yellowish-white; mantle closed, except anteriorly, presenting an orifice having its circumference finely dentated, that marks the point of passage of a moderately long, subcylindrical byssal foot; posteally it forms two short united siphons, each with 8–10 cirrhi; the upper, or anal, has a hyaline, tubular, retractile, valvular, globular membrane, which is in frequent action, and appears to regulate the propulsion of the fæcal matters, and the ingress and egress of the water for the various purposes of the animal œconomy, which will be fully explained in the observations on the *Pholadidæ*.

On each side of the body there is a pair of very unequal branchiæ, which hang obliquely, the upper being narrow, the lower larger and more triangular; their colour brown, smooth on their outsides, and finely striated within; on each side there are two long, narrow, pointed, brown pendulous palpi, pectinated strongly on both surfaces. Besides the red points circling the cirrhi of the siphonal tubes, there is a dark line encompassing both at a short distance from the cirrhal circle of points; these are better seen in the dead animal. The liver is black-green.

We have taken, in the deepest part of the British Channel, conglomerations of many thousands of this species of all growths, having shells of brown and white, and often roseate hues; they adhere to each other by fine silky byssal filaments.

The *C. ovata* is a doubtful British species, and Mr. Walpole, of Monkstown, Co. Dublin, having favoured us with a specimen of his *C. rosea*, we can only consider it the common roseate variety of *C. nucleus*. Since the above remark, Mr. Walpole has informed us, that he has submitted specimens to Professor Forbes, who has come to the same conclusion. As to the *C. ovata* and *C. rosea* of the 'British Mollusca,' we supply the following references:—

C. ROSEA, Brown.

C. rosea? Brit. Moll. i. p. 185, pl. 9. f. 13, 14.

C. OVATA, Forbes.

C. ovata? Brit. Moll. i. p. 187, pl. 9. f. 15.

SPHÆNIA, Turton.

S. Binghami, Turton.

S. Binghami, Brit. Moll. i. p. 190, pl. 9. f. 1, 2, 3.

Animal elongated, compressed, pale yellowish-white; mantle closed, except a passage anteally for a small, narrow, subcylindrical foot, of a bluish transparent colour, with a byssus of coarse filaments, and another for the anal and branchial tubes. The anal siphon is short, but the longest of the two; it is encircled by 5–6 rough white cirrhi, and emits a large, subhyaline, delicately frosted valve, which, on *each* step of the animal in advance, is considerably exserted, and then suddenly withdrawn; the branchial siphon is little more than a sessile orifice, but in connection with the anal one, and, like it, furnished with 5–6 rough white cirrhi. The branchiæ are of a pale brown, the under one being the largest, and runs horizontally; the upper is much smaller, and laps on the other obliquely; the branchial vessels are so minute as to give the laminæ the appearance of smoothness; there is, on each side, at least *one* subtriangular, pointed, well-striated palpum, and it is probable there is a second that has escaped detection.

This animal has great affinity to *Saxicava*, besides alliances with *Corbula* and *Mya*; indeed the genus *Sphænia* is almost unnecessary, as its animal is nearly identical with *Saxicava arctica*, and the structure of the hinge and the other hard parts have much the same generalities. In our dubiety whether this animal ought to be deposited in *Sphænia* or *Saxicava*, we have cut the Gordian knot, by adopting, contrary to our particular views, an almost superfluous genus, being in some measure stimulated to this resolve by the respect we entertain for the memory of our old talented friend Dr. Turton, its founder, whose numerous works are so highly valued by conchologists.

PANDORA, Lamarck.

P. obtusa, Leach et Auctorum.

P. obtusa, Brit. Moll. i. p. 210, pl. 8. f. 5; (animal) pl. G. f. 10.

Animal suboval, somewhat elongated; the left side is more

tumid than the right: the mantle is closed, except a small fissure at the anterior end for the issue of the foot; posteriorly it forms a sheath, which encloses the very short, scarcely separated siphons, that merely show their extremities, which are fringed at the orifices with fine white short cirrhi; the margin of the sheath, in some specimens, is marked with a fine orange line, and the base of the cirrhi and margins of the orifices are usually encircled with a dead-white narrow thread.

With regard to the branchiæ, I have great satisfaction in stating, that after the examination of many live specimens, I am enabled to settle the true character of them. I have been most anxious on this head, as the statement in the 'British Mollusca,' pp. 210–212, is given from old notes of mine in 1835, in which it is observed, that there are two palpi and one branchial lamina. Later and repeated examinations require the following rectifications. I can now say, beyond dispute, and show the fact by preparations, that there are two palpi and two branchiæ on each side of the body; the branchiæ run horizontally, being long, narrow, slightly arcuated, and symmetrical, pale brown, and pectinated by the blood-vessels on both surfaces; their posterior points pass into the branchial tube; the palpi are short, small, pale brown, triangular, pointed, and striated transversely. The ovarium is orange-coloured, and placed posterior to, and in contact with, the dark green liver: in the genial months the ova, in all stages of development, are very conspicuous, which, we think, on exclusion pass, without any delay in the branchiæ, into their native element. The intestine passes out of the posterior basal part of the liver to the bottom of the body, and then ascends under the branchiæ and adductor muscle to its termination in the anal tube.

This very elegant species, both as to the animal and shell, is sufficiently plentiful, alive, at Exmouth, in the coralline zone.

P. ROSTRATA, Lamarck.

P. rostrata, Brit. Moll. i. p. 207, pl. 8. f. 1–4.

This species is an inhabitant of the Channel Islands; we believe there is no well-authenticated capture of a live animal on the strictly British coasts.

SOLENIDÆ.

Agreeably to our method, this family contains only two British genera, *Solen* and *Solenicurtus*; the first has five, the latter, two species. *Solen* is a singular genus, its transverse measure in some species being 8 to 1 of the vertical. The foot occupies one end of the shell, the buccal orifice the middle, and the posterior portion contains the short siphons, which are nearly united, except in *S. legumen*, in which they are somewhat longer and more divergent. They have alliances with the *Gastrochænidæ*, and by the long linear branchiæ with the *Pholades*; but the ample notes on the principal species will give the necessary explanations.

SOLEN, Linnæus.

S. SILIQUA, Linnæus et Auct.

S. siliqua, Brit. Moll. i. p. 246, pl. 14. f. 3; (animal) pl. I. f. 1.

Animal subcylindrical, pale drab; the mantle is yellowish-white, tumid at the extremities, swelling beyond the margins of the shell, closed throughout, except a central narrow rayed slit, which appears to have no other use than to admit water to the branchiæ, in aid of the pedal orifice, which in this family is greatly contracted by the shape and position of the foot; it is also produced into a siphonal sheath, truncate at the extremity, bordered by a fine brown line, and which contains two short siphons, just separate at their terminations; they are never extended much beyond the shell; the upper is rather the shortest, and of less diameter than the branchial tube; it is encircled by two rows of irregular cirrhi, which do not quite reach the orifice, the margin of which is plain; the lower one has about twelve rather long, tumid, pointed, white filaments; the upper, about twenty cirrhi, of three lengths and sizes, marked with fine brown lines and blotches at their bases, edges and summits; the branchial siphon has also two rows of similar cirrhi; in the lower one

there are about fifteen, and in the upper, thirty of different sizes. The foot is long, strong, muscular, and subcylindrical, fixed to the comparatively small body about the middle of the shell; it has the power of changing the terminal portion into all shapes, from the fine elongated tentacular point, to the decided club-shaped extremity; the foot, when half-extended, is oblique, and obtusely pointed; the colour is pale yellow-white, marked for some distance anteally with exceedingly fine, very pale, close, lead-coloured lines.

The animal has two systems of locomotion; the one for ascending from its deep perpendicular hole, the other for changing its locality, which it can effect by darting forward with a rapidity equal to that of the *Pectines*. The foot has a decided tubular aquiferous canal, from its junction with the body to within a short distance from the termination; the outer tissue appears homogeneous, but the entire conical cavity is furnished with strong elastic fibres, which doubtless have the power to close or greatly contract it. How the water gets access to the cavity is doubtful; I could detect no orifice either at the point or junction with the body; one must suppose it to enter by the mouth, stomach, and walls of the crystalline stylet, and, from thence, to have a contact with the enveloping membrane of the viscera, if not an inward communication. What is the particular œconomy of this sort of foot, which is in some measure analogous to that of the *Lucinæ*, only in them it is perforated throughout, is at present hypothetical. Can it be, in *Solen*, to give it increased power and elasticity, and in its deep hole of two feet or more, by a sudden compression to aid the muscular extension, which alone could not effect the ascent of the animal from its deep lodgement? and is the compressive action also the agent to enable it, when out of its retreat, to dart with such unusual rapidity?

There are on each side a pair of equal-sized, long, linear, narrow branchiæ, which, after getting rid of the interposition of the body, proceed, fixed to the roof of the long dorsal range of the mantle, to the branchial siphon, each pair united to the other, to deposit in it their attenuated points, as in the

Pholades. I believe there is no communication between the siphons, but I have not proved this fact by injections, as in *Pholas*. The branchial transverse vessels, artery, and vein are very distinctly marked; there are, in connection with the laminæ, a pair, on each side, of pale brown, thin, small, delicate triangular palpi, smooth without, striated within. The liver is composed of distinct aggregations of light greenish or yellowish masses, with the ovary united to it more anteally. The crystalline stylet is very long, but the tricuspid membrane or attritor is without much consistence; it works, however, in the stomach. The general anatomy is in most respects as in *Pholas*, but it has two adductors, instead of the single post-medial one of that genus, and, as in it, the intestine plunges into the body, then ascends, and runs posteriorly on the dorsal range embraced by the heart and auricles, and discharges into the anal conduit by a white pendulous rectum. The branchial and anal siphons being short, may possibly be confluent as in the short-tubed animals, in which case the entire ventral cavity must be considered as one large branchial siphon, divided by a septum at their termination.

This animal represents the typical Solens. We may observe, that the long branchial cavity in some measure supplies the place of the elongated siphons of the *Pholades*.

S. PELLUCIDUS, Pennant et Auct.

S. pellucidus, Brit. Moll. i. p. 252, pl. 13. f. 3; (animal) pl. I. f. 2.

Animal elongated, compressed; mantle of the palest drab, closed ventrally, without the central assistant branchial slit as in *S. siliqua*, open at both ends for the passage of the foot and siphons; these latter are very short, scarcely protruded beyond the shell; the branchial has about ten cirrhi, edged with fine brown lines, with one or two smaller ones between each; the anal tube is plain, or scarcely broken into points of a pale brown, and on both are a few large, rather long, white filaments, springing from the body of the common sheath, just below the siphonal orifices. The foot is much less

cylindrical than in *S. siliqua*, thus affording a sufficient pedal entry for the water, and is without the central fringed fissure of *S. siliqua* and *S. ensis*; it is attached to the body about the middle of the shell, being obliquely truncate, and can, like its congeners, assume the pointed, lanceolate, or club-shaped terminus; the colour is that of a pale morello cherry, of paler and intenser hues.

The animal is capable of the most rapid locomotion; I have seen it dart in a large dish with the velocity of the *Pectines*. It lives, as the *S. siliqua*, in a perpendicular hole, and, like it, uses its powers of locomotion to change its habitat.

There are, on each side, a pair of pale drab, long, linear branchiæ, the upper not half the depth of the lower one, and after leaving the body, they run, fixed on the long dorsal range of the mantle, and then unite and enter the short branchial siphon. There are also, on each side, a pair of small darkish-drab triangular palpi, smooth on the outer surface, and pectinated within. The liver is quite on the dorsal line, green; and below it, in close connection, is the ovary, filled at this season (22nd July) with round, flake-white ova. The stylet and tricuspid membrane or stomachal attritor are present. The connecting strap-shaped labia of the palpi around the mouth are as in *S. siliqua*.

S. ensis, Linnæus et Auct.

S. ensis, Brit. Moll. i. p. 250, pl. 14. f. 2.

Animal elongated, subcompressed, that is, less cylindrical than in *S. siliqua*, but more so than in *S. pellucidus*; the mantle is open at both ends, and has the fringed central fissure, with the same character of the tubes, cirrhi, and colours, as in *S. siliqua*. The branchiæ, labia, and palpi are proportionately the same; the foot, though less cylindrical, is capable of the same changes of form, but instead of being at the termination truncate and rectangular, it forms an oblique sweep; and the colour at its extremity, in lieu of being pale cloudy-white, is studded with very minute papillæ, and meandering red-brown lines in the interstices, only to be seen

by a lens. The liver forms the same granular brown masses, connected anteally towards the lower part of the body with the ovary. The crystalline stylet or attritor is present.

We may state, that excepting the narrower arcuated shell, lesser size, and the oblique termination of the foot, it is the prototype of the curved variety of *S. siliqua*.

S. LEGUMEN, Linn. et nobis.

Ceratisolen legumen, Brit. Moll. i. p. 256, pl. 13. f. 2; (animal) pl. I. f. 4.

This animal is subcompressed, and in comparison with its congeners only presents specialty-variations, the principal one being the greater extension, separation and divergency of the siphons. We do not see any sufficient character to remove this species from *Solen*.

The undermentioned species, though occasionally taken alive at Exmouth, has not occurred to us.

S. MARGINATUS, Pulteney.

S. marginatus, Brit. Moll. i. p. 242, pl. 14. f. 1; (animal) pl. I. f. 3.

SOLENICURTUS, De Blainville.

S. COARCTATUS, Gmelin.

S. coarctatus, Brit. Moll. i. p. 259, pl. 15. f. 3; (animal) pl. I. f. 5.
S. antiquatus, Auctorum.

Animal oblong, reniform, subcompressed, white throughout. Mantle closed, except anteriorly, for a large, thick, linguiform foot, and posteally it forms a common sheath, from which the siphons spring; the branchial tube is only cirrhated at the orifice, and the animal often inflates both to three times the ordinary diameter. The branchiæ are a pair on each side, long, narrow, attenuating posteriorly, and, as in the *Pholades*, are partly deposited in the branchial department of the siphonal sheath; the corresponding pairs of palpi are long, slender, triangular, well-pectinated within, and less so on the outside. There is no byssal groove in the foot. This species has the greatest analogy to the Solens, but subject to some modifica-

tions of the foot and shell, from which its generic appellation originates.

Some malacologists have an idea, that this creature, and that of *S. candidus*, is too large for its habitation; this is a mistake, which has arisen from the animal when in confinement exserting the belly of the mantle, inflated by water, beyond the margin of the shell; but the instant it is irritated, it can place every organ *à l'abri*. *S. candidus* is in the same category as to this point. This account is partly from the recollection of twenty years ago; there are gaps in it which we hope to make good. We have, though rarely, taken this animal alive at Exmouth.

S. CANDIDUS, Renieri.

S. candidus, Brit. Moll. i. p. 263, pl. 15. f. 1, 2.
Solen strigillatus, Anglorum.
S. scopula, juv., Anglorum.

We have been favoured by Dr. Battersby of Torquay with fresh, though not live, specimens of this species. To describe it would be nearly a repetition of the notes on *S. coarctatus*. The only variation in the animal is its being of a flesh colour, tinged with orange. We have rarely dredged the shells of this species, but never with the animal, in the coralline district at Exmouth.

GASTROCHÆNIDÆ.

Gastrochæna, *Saxicava*, *Panopæa*, and *Venerirupis* are the genera which receive the British species; they are allied to *Pholas*, by being borers, except perhaps *Panopæa*, and having their mantle closed; they have also a similar siphonal apparatus, which according to their minor volume is as proportionately elongated; but most of them differ in having the siphons soldered together, showing externally a depressed line of separation, and have not the appearance of being enclosed in a common sheath.

The genus *Petricola* has been associated with this family. A couple of specimens of *P. lithophaga* have been forced into the British list which are from habitats altogether apocryphal; the one is stated to have occurred in *clay* at Bristol, the other, from discharged ballast in Cork harbour,—a most suspicious receptacle. Those who wish to see an account of this species may consult the 'British Mollusca,' i. p. 151, pl. 6. f. 9, 10; (animal) pl. G. f. 1. We believe it is not indigenous.

GASTROCHÆNA, Spengler.

G. MODIOLINA, Lamarck.

G. modiolina, Brit. Moll. i. p. 132, pl. 2. f. 5, 6, 7, 8; (animal) pl. F. f. 5.

Animal clavate anteriorly, attenuated behind; pale brown; mantle closed, except an aperture in front for a small subcylindrical byssal foot; the texture is thin on the dorsal range, ventrally extremely fleshy, being composed on the inner surface of thick muscular pale green folds and rugosities. M. Deshayes considers these substances secreting glands; others, as ovaria; we concur with that naturalist, and think they may produce the matter for the linings, and the viscous fluid for the agglutination of the molecular particles used in the construction of the tubular dwellings of these animals, when they are not in calcareous deposits. The siphonal tubes are elongations of the mantle, soldered on each other nearly their whole length, which in the greatest extension are about three times the length of the shell, and are even longer in proportion than those of the *Pholades*. M. Deshayes observes, in his comment on Lamarck, that the tubes are very short when the animal is contracted; but this is so in every other bivalve under a similar condition; their colour is pale reddish-brown, and both orifices have short cirrhi of an intense rufous hue. The branchiæ are pale brown, suboval, hanging horizontally, of small depth, gradually becoming posteriorly more linear, having their terminations deposited in the siphonal tube; the texture is thin, and they are finely pectinated on

both surfaces; the pair of palpi, on each side, are subtriangular, pointed, smooth without, but striated on the internal faces.

I believe one of the objects of the folds in the ventral portion of the mantle is to give greater elasticity and strength to that organ, in rubbing out the habitations of these creatures when in *limestone*. Many conjectures have been hazarded, how the animals of *Gastrochæna*, as they grow, form and increase their flask-shaped habitations of agglutinated particles of gravel, sand, and shelly spoil, when they are located in old dead bivalve shells. I think the solution of this point presents no particular difficulty. The enlargement is effected, as in the shells of the ordinary bivalves, by the periodical additions of testaceous matter, and of internal lining, to the gradually progressive excavations or tubular constructions, until the animal comes to maturity. It is an error to suppose that an animal, at any particular stage of its increment, before it has arrived at the full size, becomes completely encased, and in consequence must find some mode to extend the dimensions of its habitation in proportion to its own increase; such an operation is impossible, except by chemical or mechanical means; but absorbents and solvents, even if we admit their application to calcareous matter, and that they have a solvent power not subject to neutralization, certainly would have no effect on the tubes that are often formed, of flinty and corally spoil. We believe that the fact is, the animal in some deposits is never entirely enclosed before it is adult, and that it increases its incipient cavity from the point on which it is first cast by regular progression until full maturity, when a final closure takes place, which is the test that further enlargement has ceased. We consider these views are analogous with the doming of the shell of the *Pholas papyracea*, which is delayed whilst the animal gradually enlarges its habitation until the full growth determines the final closure.

The foregoing remarks have chiefly reference to the pear- or flask-shaped excavations and constructions in old bivalves. There is greater difficulty to account for the progressively

increasing enclosed excavations of the *Gastrochænæ* deposited in limestone. We can only suppose, that as additional space is wanted, it is procured by attrition, and the spoil either discharged, when swallowed, through the intestine, or the shelly canals of the tubes, those organs being first withdrawn, and placed in a position to clear it out by the ejection of a current of water.

SAXICAVA, Fleuriau De Bellevue.

S. RUGOSA, Linnæus.

S. rugosa, Brit. Moll. i. p. 146, pl. 6. f. 7, 8; (animal) pl. F. f. 6.

Many conchologists are of opinion that *S. arctica* and this species are identical; we do not concur with them, as, in our opinion, even the conchological indices sufficiently establish specific distinction: the examination of many of both of the same size, say $\frac{3}{4}$ths of an inch, shows that there are organic grounds for specific separation. The tubes of *S. rugosa* do not diverge so much, the cirrhi of the orifices are more simple and slender, and the sutural line of the siphons is less pronounced. When the present species is in sea-water, it opens the valves of the shell to the extent of at least $\frac{4}{10}$ths of an inch, but a similar-sized *S. arctica* only $\frac{1}{10}$th: this circumstance is occasioned by the greater mass of folds and rugosities of the mantle in *S. rugosa*, which act as springs to enable the animal to open the valves as wide as in *Gastrochæna modiolina*, of nearly similar structure and habits. The uses of these wide openings are to afford the two last-named species a greater ventral mantellar surface to hold the siliceous particles, or fine sand imbedded therein, to rub down their stony habitations; but in *S. arctica*, which is a very doubtful borer, the mantle is less thickened ventrally, and will not allow of anything like the extension noticeable in *S. rugosa*. We have carefully examined the surprising difference of the muscular thickness of the mantle in the two species, and have found it constant.

The branchiæ, palpi and byssus of this species are so similar in *S. arctica*, which follows next, that we refer to it; but

the foot in *S. rugosa* is attached to the body by a globular base, whereas in *S. arctica* the pedicle is more linear. The valves of the shell in *S. rugosa* are, though often distorted, usually symmetrical, rarely locking into each other; and the habitat of the two, at least at Exmouth, is essentially different, the *S. rugosa* dwelling in the littoral and laminarian sandstone rocks, and the other, in the crevices of old bivalves amidst masses of *Serpulæ*.

S. ARCTICA, Linnæus.

S. arctica, Brit. Moll. i. p. 141, pl. 6. f. 4, 5, 6.
Solen minutus, Auctorum.

Animal subcylindrically elongated, body mottled white; mantle thick, but not so fleshy, nor wrinkled into muscular folds, as in *S. rugosa*, of a pale yellowish-white; closed, except an opening for a narrow strap-shaped foot with a byssal groove and obtuse termination. The siphons, when extended, are longer than the shell, of a pale yellow at their base, and orange at the extremities; they are soldered to each other to a short distance from their terminations; they then separate, by the anal diverging and curving upwards, and frequently protruding a globular transparent valve; the orifices of both are encircled by 16–20 dirty-white short cirrhi; a light brown epidermis covers the ventral and dorsal margins, and is continued on the siphons to their termination, giving their really yellow colour the aspect of a brown skin, which, however, appears to be an adscititious deposit, and not an extension of a true mantellar membrane that is reflexed on the shell. The branchiæ are pale brown, narrow, hung horizontally, the upper ones are the smallest; these are accompanied on each side by a pair of very small triangular palpi, of pale yellow hue.

This species, I believe, is not strictly a borer; it is very rarely found in company with *S. rugosa* in the triassic sandstone, in which the latter abounds; though often taken free, it is generally nestled and fixed by its byssus in the interstices of the various masses of *Serpulæ* that clothe the surfaces of old bivalves and other marine substances. At Exmouth it is always taken in deep water in the coralline zone. The right

valve is usually more convex than the left, which in most specimens locks into it, like that of the *Pandora obtusa* and *Corbula nucleus*. This species, though less smooth and regular than our *Sphœnia Binghami*, is nevertheless extremely similar both as to shell and animal, and has, in consequence, been often confounded with it; it is, however, distinct, and the dentition always preserves a constant different character.

VENERIRUPIS, Lamarck.

V. IRUS, Linnæus.

V. irus, Brit. Moll. i. p. 156, pl. 7. f. 1, 2, 3; (animal) pl. G. f. 2.
Donax irus, Auctorum.

Conchologists, by the character of the teeth of the only species of this genus, would place it amongst the *Veneridæ*, but malacology informs us, that it is as decided a member of the *Gastrochœnidæ* as *Saxicava*. We have examined a fresh, though not a live animal, taken alive on the southern coasts; the closed mantle, foot, and siphons are similar to the *Saxicavæ*. Dead shells are often procured in the red sandstone at Exmouth, but it has not occurred there in a living state; it is only found in deposits that have been partially deserted by the sea; we have little doubt, that if the rocks which are never uncovered at the lowest tides could be examined, it would be found alive. We have here a practical illustration of the superior attributes of malacological determinations.

PANOPÆA, Menard de la Groye.

P. NORVEGICA, Spengler.

P. norvegica, Brit. Moll. i. p. 174, pl. 11, and iv. p. 249.
Mya norvegica, Auctorum.

Animal oblong, thick, pretty much the shape of the shell, which gapes basally at the anterior end, and is obliquely truncate posteriorly, with a very large gape. Mantle thick, closed, except the pedal and siphonal apertures, pale drab, but covered with a black skin. The orifice for the issue of

the foot is very small; the tube is of large diameter, and, when fully extended, is 7 inches long, fleshy, and covered with a dark epidermis, which gives it as rugose an aspect when under contraction, as that organ in *Mya truncata*; it forms near the extremity the two siphonal orifices, which are scarcely separated, the upper or anal one being rather the shortest; they are both furnished with short, simple, white cirrhi, not digitated or fimbriated as in some of the *Myæ*. The branchiæ are extensive, but not deep, well arcuated on the body, the upper plate lapping only on half the surface of the lower one; they are very long, and after quitting the body, gradually taper, becoming linear, and are prolonged nearly to the extremity of the siphonal apparatus, terminating in acute points, and cannot be much less than 6 inches in length; the colour on the body portion is light drab, rather sparingly aspersed with minute bistre-coloured points; the pectinations on the part coasting the body are visible, but not strong; as they advance they become coarsely crimped or wrinkled. The anal and siphonal issues are not separated their whole length from the extremities to the body, by an impermeable wall, as in the *Pholades*, but only for an inch at the terminations, and then debouche into the main tube; the branchiæ in *Gastrochæna* and *Saxicava* are of the same linear complexion, and similarly deposited in the main tube; the palpi are long, slender, delicate, pointed and triangular, united around the mouth, pale drab, very finely pectinated without, and smoother within. The body is of a thick oval mould, pale pinkish-drab, and from its centre a very small byssal-grooved foot proceeds, which, as far as could be judged, would, when exserted, produce a subcylindrical one, like that of *Saxicava* and *Gastrochæna*; it is certainly less linguiform than in *Mya*, which also differs from it in having *no* byssal groove. The liver, as usual, is green. In other respects there is nothing peculiar in the aspect of the animal. There was no byssus in the groove of the heel of the foot.

This species has not yet been found on our southern shores; it has, however, been reported from Scarborough. The above remarks are from the examination of an adult animal sent us

in a perfectly fresh state by Mr. Howse, of Newcastle-on-Tyne, who kept it alive several days; it was taken off the Fern Islands, on the coast of Northumberland, in deep water, in March 1852. It is closely allied to *Mya*, from which it differs in having a narrower foot, with a byssal groove; there is also a more developed tooth, and the ligament is much more external. But it is still closer to the genus *Saxicava*, of the *Gastrochænidæ*, scarcely differing therefrom; the hinge of which is all but identical, having the small conical tooth in each valve; the adductor, pallial and siphonal cicatrixes nearly agree in shape, colour, and position; the character of the foot is similar, and many of the *Saxicavæ* are often found with as proportionately large posterior and anterior ventral gapes: the principal difference is in the aspect of the tubes of the two, which in this species is the counterpart of that of *Mya truncata*, whilst in *Gastrochæna* and *Saxicava* they appear as two tubes soldered together, showing sometimes the real divisional line marking the extent of the internal wall between them, and sometimes only an apparent depression on the common sheath. This comparison of the two genera would appear to show that the appellation of *Panopæa* to our unique British species is almost superfluous, and that it might have merged in the *Myadæ* or *Gastrochænidæ*.

MYADÆ.

This family only contains the genus *Mya*, with a very few species, *Lutraria* being merged in it; it is allied to the *Pholades* by the characters of the branchiæ, the closure of the mantle, and the powerful siphonal apparatus; the generalities of the anatomy scarcely differ. The so-called *Lutrariæ* have been associated with the *Mactridæ*, but they have very little similarity, except in the shape of the foot, and the triangular or V-shaped tooth; the mantle of the one is entirely closed ventrally, and has exceeding long siphons; in the other it is open, as in the *Veneres*, with very short tubes.

MYA, Linnæus.

M. TRUNCATA, Linn. et Auctorum.

M. truncata, Brit. Moll. i. p. 163, pl. 10. f. 1, 2, 3; (animal) pl. H. f. 1.

Animal elongated, subcompressed; mantle pale brown, closed throughout, except an anterior fissure for a moderate tongue-shaped, yellowish-white foot, with a byssal groove, and being also produced into a long brown sheath covered with a dark rugose epidermis, under which the skin is white; it can be extended to double the length of the shell; when contracted it presents the aspect of a mass of close-set annular corrugations; the sheath also contains the anal and branchial siphons, which are united to their terminations, and scarcely appear beyond the walls of the common envelope; the former, besides the usual exsertile valve, has about fifteen short dirty-white cirrhi, with as many still shorter between them; the latter has twenty similar filaments, with intermediate short ones. There are on each side a pair of pale brown branchiæ, rather narrow, the upper being somewhat less in depth; they are well pectinated on both surfaces, and their points enter the branchial sheath, but not to near the extent of the *Pholades*; the two pairs of palpi are large, basally broad, triangular, of excessive thin texture, marked with fine short brown minute dots, and end in a sharpish point; they are connected together by labia coasting the buccal orifice, and are visibly pectinated on both sides. The liver is dorsal, granular and yellowish-green, having the ovarium in contact anteally and ventrally. The stylet and stomachal attritor are present.

This animal is a littoral species, inhabiting the shingle, and the sandy estuaries. It is also taken alive in the coralline zone.

Bath, 21st January, 1851.

I have stated above, that the foot has a byssal groove; a careful examination of a lively specimen sent me this day from Exmouth, proves that I was mistaken; the foot, though rather smaller in proportion than in the next species but one, the *Mya oblonga*, nobis, the "*Lutraria*" of authors, is, like it, without a trace of byssal groove; the branchiæ and palpi of our present species, the type of the family, present the same

characteristic form and appearance as in the so-called *Lutraria oblonga* and *L. elliptica*.

M. ARENARIA, Linn. et Auctorum.

M. arenaria, Brit. Moll. i. p. 168, pl. 10. f. 4, 5, 6.

We have not observed this species, but the recorded accounts of it show that it differs little from the type.

Having ventured to consider *Panopæa* a superfluous genus, it is impossible that we can for a moment conscientiously maintain a still more unnecessary one, the "*Lutraria*" of authors; our description will show that the present animal is in all essential points a *Mya*; the differences of the specialties of the soft parts are scarcely worth notice, the cirrhi being red-brown instead of white, and the terminations of the siphons slightly forked, whilst in the type, the *M. truncata*, there is no separation. The greatest variation between the two is in the hard parts, but I trust, at the present epoch, we are not to adopt precepts of zoology which would be incompatible with the present position of the sciences; that because an animal shuts the door of its house by a different-shaped hinge from that of its congener in all other respects, it is to be considered, on that account, generically distinct: we may as well say of two similar doors, that because one has the patent hinges and the other the common sort, they are distinct kinds of objects; it is the same with the *M. oblonga*: gentlemen may call its animal by the name of *Lutraria*, but that does not make it less a *Mya*. We maintain the position that there is not a trace of generic distinction between the typical *Mya* and the so-called *L. oblonga* and *L. elliptica*, and that there are no more decided specialties between them, than between the species of every other genus. *Lutraria* has not a malacological support; it entirely rests on the artificial grounds of variation of the dentition of the hinge; for the ligament or cartilage is what is called internal, both in *Mya* and *Lutraria*; we therefore consider that an essential service is done in proposing to relieve science of a useless genus, which has not

even the excuse of an extraordinary number of species as a sort of palliation for its constitution.

M. OBLONGA, nobis.

Lutraria oblonga, Chemnitz.
——— ———, Brit. Moll. i. p. 374, pl. 13. f. 1.
Mactra hians, Mont. et Auct.

Animal oblong, tolerably thick, very pale yellow, with the mantle closed, except a large anterior fissure for the foot; it is also produced into a large, rugose when contracted, sheath, but not so much so as in *M. truncata*. The ground colour is white, but covered with a brown epidermis, which also is deposited on the ventral regions of the mantle; the common sheath, containing the two siphons, can be greatly inflated, and is often extended twice the length of the shell; it only just bifurcates at the terminus, showing the orifices of the siphons; the anal is of much less calibre than the branchial, and encircled by 30–40 short, fine, simple, red-brown cirrhi; the branchial has about the same number, of similar colour, half of which are stronger and longer than the others, being fimbriated on each side; the remainder are interstitial. The foot is large, rather fleshy and linguiform, white, with a tinge of pale brown, and without a byssal groove. On each side there are a pair of branchiæ and palpi; the former are narrow, not strictly linear; the upper one is not so deep as the under one anteally, but posteally they are much of the same dimensions, having their points deposited in the branchial siphon; they are pale drab, with the transverse vessels of the circulation well marked on both sides. The palpi are very large, triangular, pointed, of very thin membranous texture, pale brown, and elegantly aspersed with minute red-brown points; the two pairs are united by plain labia passing around the mouth.

We have taken this species at Exmouth alive: though very large valves are taken in the dredge, and continually cast on shore, it is singularly scarce, probably inhabiting the littoral limits, and lodged so deep as to escape detection and the action of the dredge. The above is taken from a fine 4-inch specimen sent me to Bath, this 21st January, 1851, having been

cast on shore at Exmouth during the late gales; it arrived quite lively, wrapped in fucus, and accompanied by sea-water. It proved an important acquisition. I ascertained, both anatomically and practically, that there is no connection between the branchial and anal siphons, affording another proof that there is an end to the doctrine of separate branchial currents by cilia.

M. ELLIPTICA, nobis.

Lutraria elliptica, Lamarck.
———— ————, Brit. Moll. i. p. 370, pl. 12; (animal) pl. H. f. 2.
Mactra lutraria, Auctorum.

Animal compressed, subovally elongated, white. The mantle, ventrally, has the margins united by a fine, white, minutely crenulated line, which marks the suture, except for a space of about one-third of the posterior portion of the pedal fissure, which is edged by rather distant fine white filaments, and affords a passage for a large thick tongue-shaped white foot, without a byssal groove. The siphonal sheath is very large, subcylindrically tapering, and, in a shell of $3\frac{1}{2}$ inches transverse measure, is, when in full activity, 6 inches long; from its base for 2 inches it is white, and for another 2 inches marked with zigzag purplish-brown blotches, which at the terminal portion become distinct, dark purplish-brown dots; on the surface of the sheath there are two or three circular brown lines, an inch apart, and it is covered with a transparent corrugated skin, which appears to be a prolongation of the light horny epidermis that clothes the exterior of the entire area of the valves; within the sheath are the anal and branchial siphons, both furnished at their terminations with numerous white cirrhi, minutely spotted with dark purplish-brown or red; the branchial cilia are the longest, delicately fimbriated on the margins with alternate smaller and shorter ones; the anal are of the same colour, but shorter and more numerous. The branchiæ are pale brown laminæ, not deep, the upper ones being rather the lesser; they are hung transversely, with their points lying in the branchial cavity; the minute vessels of the circulation give them the appearance of

fine pectinations; the pairs of palpi, which are pendent from each side the buccal orifice, and united around it by a membrane, are paler than the branchiæ; they are long, triangular, pointed, of fine texture, and delicately striated. All the *Myæ* exsert from the anal siphon the usual tubular hyaline valve.

This species inhabits the low-water levels of the littoral zone, in the loose sandy districts, and are enabled, by the powerful foot and siphonal sheath, to bury themselves more than a foot in depth. It is also taken in the coralline zone at Exmouth.

PHOLADIDÆ.

Pholas, Teredo, and *Xylophaga* constitute the British genera of this family. I have submitted the *Pholades* and the *Teredo megotara* to a close examination, not only of the external organs, but I have entered into detailed observations on their anatomical structure. Grave errors exist in our records relative to this family, both as regards the shells and the functions of the soft parts.

It is really strange that in so celebrated and ancient a genus as *Pholas,* so often the theme of discussion, so many doubts and contradictory accounts should still prevail respecting the hinge, cartilage, ligament, and adductor muscles of the animal. Though there may be many errors, I think that malacologists will find, in this account, some rectifications, obscure points explained, a variety of new matter, and that the observations on the structure of *P. dactylus* and *Teredo megotara* will assist not only to illustrate this family, but, *mutatis mutandis,* give a general view of the material points of the organization of the animals of the Acephala.

As I have, in the accounts below, entered so largely into the incidents of this group, I shall at once plunge "in medias res."

The first animal has caused great discussion, whether it ought to form two distinct species or only one, by considering its very different aspects as identical. We think it will

appear that only one species exists; but that malacologists may judge, we give specific descriptions of the two phases, the one being called *Pholas papyracea*, the other, *P. lamellata*.

PHOLAS, Linnæus.

P. PAPYRACEA, Solander et Auct.

P. papyracea, Brit. Moll. i. p. 123, pl. 5. f. 3, 4, 5, 6, and pl. 2. f. 1; (animal) pl. F. f. 4.

Animal elongated, subcylindrical; mantle closed, except a small rayed aperture for the foot, as long as one exists, and which corresponds in position with a similar aperture in the membrane connecting the doming of the shell, and is styled by Dr. Turton a "spiracle," but which may perhaps in this species, the only one of the *Pholades* that has it, be for the purpose of a partial issue, or rather protrusion, without the solution of continuity of the ventral membrane of the animal, of the hyaline cylindrical appendage which exists in all bivalves, to secure for it a point of support when the foot becomes so much diminished as not to afford one. In all other bivalves this stylet is not visible, being imbedded in the body and upper part of the pedicle of the foot, which is the leaning-stock or point of resistance, except in the *Anomiæ*, *Ostreæ*, and *Pectinidæ*, in which, as the foot is reduced almost to nothing, the mass of the body is the only *point d'appui*; but when the dome of the shell of the *Pholadidea papyracea* is removed, the dark basal point of the stylet presents itself in the centre of the mottled belly, precisely where the foot is placed in the group of the *Pholades*; or the fissure may be, for flux and reflux of the water for branchial purposes.

The siphonal apparatus consists of a long elastic sheath, which is often protruded to double the length of the shell, but in a state of half-extension it becomes highly corrugated; it is clothed with a dull red-brown epidermis, under which it is bluish-white; the margin of its terminus is finely fringed with short white cirrhi; within the sheath are the anal and branchial tubes, the former with the margin quite plain, but

with an exsertile tubular hyaline process; the latter is encircled by about twenty white cirrhi of different lengths.

The liver is green, and situated as usual on the dorsal range. There are on each side of the body a pair of pale reddish-brown elongated suboval branchiæ, the upper one being much the smallest, which are finely striated on the outer surfaces; their posterior extremities suddenly become linear, and are then deposited in the branchial tube; there are also two long flat linear palpi on each side, with lanceolate points; these are more striated than the branchiæ. The body is centrally subglobose, but tapers posteally and anteally to a blunt terminus, and the whole of it presents, especially in the genial season, a mottled mass of flaky-white subrotund spots or dots, with one of the termini of the elastic appendage appearing in the centre of the anterior extremity. With regard to the foot, as I have already observed, not a trace is visible, having vanished for reasons to be spoken of below.

P. PAPYRACEA, juv., nobis.

Pholadidea papyracea, Brit. Moll. i. p. 123, pl. 5. f. 3, 4, 5, 6; pl. 2. f. 1; (animal) pl. E. f. 4.
Pholas lamellata, Auctorum.

Animal nearly of the form we have just described; mantle closed, except a large aperture for the passage of the foot, which in this form of the *P. papyracea* is most apparent. The branchial processes and siphonal tubes are, in the *most minute points*, similar to those organs in the form styled *Pholadidea papyracea*, to which we refer; the body, as in it, is subglobose, and produced posteally and anteally to an obtuse point, and it is generally of a bluish-hyaline colour, with some fine anastomosing lines throughout its surface, but has nothing of the mottled appearance of *Pholadidea papyracea*; the shape of the branchiæ is the same as in its congener, but their striæ are more delicate and colour of the palest yellow; these are the mere variations of adolescence, and generally prevail where specific identity cannot be doubted, and they are deposited partially as in its congener, in the branchial tube: the palpi and liver exhibit no variation.

I now come to the most decided difference between the two animals; the foot, in the form we are now describing, is proportionally larger than in any other of the *Pholades*, of hyaline texture, springing from the centre of the body with a long cylindrical pedicle; it has a subclavate appearance, truncate at the terminus, which is of suboval form and pointed anteally and posteally, and there is no outward visible trace of the curious elastic stylet common to all bivalves, and so conspicuous in the ventral tissue of the form *Pholadidea papyracea*.

I will now make a short comparison of the two forms: it will be observed that it is stated, in the form *Pholadidea papyracea*, that the mantle is closed, except a very small aperture or "spiracle" for the foot, if it still exists; but in the form *Pholas lamellata* there is a large aperture for a foot, that is, larger in proportion than in any of the *Pholades*. The branchiæ, palpi, and elaborate siphonal apparatus are precisely the same, with only variations of colour; the bodies of the two are of the same shape, but differ in colour and markings, the one being intensely mottled, the other hyaline; the body of the one having *no* foot attached to it, but the other a very *large* one. These are the principal variations, and certainly constitute a very general difference of aspect between the animals of the two forms, and it must be admitted that conchologists and even malacologists, who have not examined with care all the conditions and incidents attached to them, have had a *primâ facie* case for doubting their identity; but notwithstanding these great and visible discrepancies, I think I shall make out a case of identity.

In the course of my examinations I was startled by the great variations in the organs of the two forms of this *Pholas*, which, twenty years ago, when I first examined this species, appear not to have so rigorously excited my notice; doubts arose in my mind, that I might be wrong in my former determinations of identity, and I wrote to Dr. Battersby to express them to him and Mrs. Griffith, both of Torquay; the latter a lady naturalist, who has taken great interest in this question; but in the summer of 1849, after a continued in-

vestigation of fourteen weeks, my doubts were dispelled, and I stated personally to Dr. Battersby, that after a careful review of all the evidences that presented themselves, I reverted to and relied on my original determination of identity of the two forms of *Pholadidea papyracea*.

This change of opinion arose from the observation that in the adult *Pholadidea papyracea*, the mottled appearance of the belly, so dissimilar to that of the form *Pholas lamellata*, was due to the extension of the reproductive membranous organs of the ovarium occupying the space usually appropriated to the foot, which I found had disappeared. This anomalous appearance excited my attention, and the reflection that with nearly absolute *cæteris paribus* in the generalities of all the *Pholades*, there was no substantial reason why one species should always be deprived of the foot, when all the others possessed that appendage, and as I had come to the conclusion that it was the boring instrument, I felt assured that this anomaly was only an apparent one, dependent on certain conditions connected with the growth of the animal. And as the very large anterior gape in all the *Pholades* is the site of the powerful foot, and is never closed up during their existence, except in this species, I became fully convinced that the foot,—having finally performed its terebrating functions, the animal consequently having arrived at full growth (the test of which is the doming and formation of the caliciform incipient tubing, which is in *Pholadidea papyracea* the last vestige of the protecting tubes of the *Teredinidæ*) — had become absorbed, on the well-known principle, that an organ from want of use is often, especially in the lower animals, followed by its total disappearance.

I have already shown that the great variation in colour and markings between the adult *Pholadidea papyracea* and the young shell styled *Pholas lamellata* is the effect of generative influences, and that its conspicuous foot, when it arrives at full growth, which is testified by its becoming completely domed, is depauperated and finely obliterated. These two great and principal variations of aspect between the two forms of *Pholadidea papyracea*, resulting from states of transition,

having I trust been satisfactorily disposed of, and every other part of the animal exhibiting a prototype similarity, it is impossible, as I think, to entertain further doubts of the positive identity of the two shells usually termed by authors *Pholas papyracea* and *P. lamellata*. I may add, that it has been asked in objection, how is it that twenty *Pholadidea papyracea* are taken for one *Pholas lamellata*, and that the two forms are not more frequently met with in the transition states? This objection quickly yields to a just view of the *Pholades* as regards habitat and other influences.

The great mass of the *Pholades* inhabit the littoral and laminarian zones, and are thus open to the attacks of a multitude of enemies; the delicate young *papyracea* suffer severely. My dredger, who for more than forty years has annually dug large quantities of all the species except *P. crispata*, states, that he constantly finds the shells of the young *papyracea* in their cavities, cleared out of the animal by minute species of Crustacea, in such quantities, that the dealers set them up with gum as a substitute for the rarer live examples, but the domed shells are rarely met with; still a portion escape to maintain the race, and some few young occasionally occur. I have personally taken them, *in situ*, in a decided transition state; it is necessary to observe that the crafty dealers produce this condition by mutilating the dome, but a lens will show the artful fracture or the natural progress of growth.

I will say a few words on the pelagic *Pholades* inhabiting masses of stone dredged up in the littoral zones of the Devon coasts, six or eight miles from land. These shells, whether they are the two forms of *Pholadidea papyracea*, or the *Pholas parva* or *P. dactylus*, are always *dwarf*. I have a curious series of minute and completely adult *Pholadidea papyracea* not exceeding a ¼ of an inch in length. Such shells are considered by the inexperienced observer as proofs that at all ages the *Pholadidea papyracea* is completely covered with a dome and continues gradually to increase: this is impossible, as when the dome and caliciform posterior extremity are once formed, all further growth is for ever terminated. The pelagic

Pholades rarely exceed ½ an inch in length, consequently these dwarf forms are the result of locality, depth of water, and many other conditions. In the deeper zones, the young forms of the present species, instead of being found in the proportion of one to twenty of the adult shells, appear in equal numbers: this discrepancy in the proportions of the young shells inhabiting the littoral and pelagic zones, must arise from the circumstance that in the deeper waters there is more room for reproduction, more sustentation, and fewer enemies; this view corroborates the doctrine above, accounting for the disparity of numbers in the littoral zones between the young and old shells of this species.

P. DACTYLUS, Linnæus.

P. dactylus, Brit. Moll. i. p. 108, pl. 3.

Animal conically elongated; body pale bluish-white; mantle tinged with yellow, very thick ventrally, posteally, and around the gape; the other portions are of the thinnest texture, closed throughout, except anteriorly a large oval aperture for the passage of the foot, and having the posterior end produced into a long retractile sheath of a milk-white colour when denuded of the epidermis, enclosing the branchial and anal siphons, which are just separated at their termini, the former with 12–16 long cirrhi, usually furnished on one side, sometimes on both, with 3–7 fimbriæ, besides one or two intermediate shorter cirrhi, which are ciliated on both sides. The anal tube is plain and slightly escalloped, but in some states it appears to have a number of short blunt cirrhi, which are not real, but occasioned by the doubling of the points of the scallops on contraction; their colour is brown, interspersed with a few white blotches, producing a pepper-and-salt appearance; the sheath for a short distance from the terminus is studded with subcircular whitish squamous papillæ. The foot is plain, hyaline, bluish-white, suboval, pointed before and behind, truncate basally, rather obliquely fixed to the body by a long cylindrical, thick, fleshy white pedicle. The sheath can be extended to double the length of the shell, and the branchial portion is often distended with water to three

times the usual size; its diameter greatly exceeds the anal one. There are on each side of the body a pair of long narrow symmetrical branchiæ; these are nearly of similar size, reaching fully to the anterior end, from which they taper gradually posteally, and lie, not free, but fixed throughout their extent to within ½ an inch of the branchial compartment; they are pale brown; the branchial vessels are transverse, large, but not crowded, and present the aspect of coarse pectinations. On each side of the body there is a pair of the palest bluish-white, large, subsymmetrical, fleshy, pointed palpi, representing very elongated triangles; each pair is connected with its correspondent one by fillets above and below the mouth; they are strongly obliquely striated, as well as reticulated, though irregularly, on the inner surface by the vessels of the circulation; on the outer side the striæ or reticulations are not apparent. The branchiæ at their anteal angles effect a contact with the palpi at their posteal points. The outer palpum of each pair appears rather less, and more laminar than its fellow. These appendages are usually considered to be of a tentacular nature, to conduct the aliment into the mouth: they may be; but they have also branchial functions, as they are connected with each other by a very visible artery that coalesces with that of one of the main branchiæ, and I have not a doubt that leading branchial veins form a similar union with those of the regular branchiæ. The liver is anterior, of ample volume, granular, and yellowish-green.

P. PARVA, Pennant.

P. parva, Brit. Moll. i. p. 111, pl. 4. f. 1, 2. pl. 2. f. 2; (animal) pl. F. f. 3 & 3 *a*.

Animal thick, subcylindrical, less elongated than its congeners; body milk-white; mantle pale bluish-white, when deprived of the fugacious light-red epidermis, which, at the closure of the valves, forms a line resembling a suture of a red sandy colour: this division of the body causes each side of it to appear banded. The mantle is closed except an aperture for the foot, and is prolonged into a long retractile sheath

covered with a thick red-brown epidermis, which is aspersed with thick-set sand-like red eminences, or minute papillæ, that become larger and more intense at the termini of the orifices, where its margin is irregularly encircled with a fine light brown fringe or rather pile; within the periphery of this fringe are the siphonal apertures, the branchial one being rather the longest, without cirrhi, but sinuated or escalloped, and marked with a dozen brown and white alternate lines running into the tube; these at half-contraction have the appearance of short blunt cirrhi, occasioned by the doubling of the brown and white points of the scallops, the two nearest the anal tube being the longest in appearance, with a single one exactly opposite the two; these however are only deceptions, and vanish entirely when the tube is fully expanded; the anal cylinder is pale brown and perfectly simple; both siphons are destitute of cilia, having only the margins of the sheath finely pilose; none of the other *Pholades* are without cirrhi on the branchial orifice. The foot, when at rest, is nearly an oval, but in action it becomes pointed behind and rounded in front; it is truncate at the base, and fixed to the body by a long round cylindrical fleshy pedicle of a pale bluish-white colour. The branchiæ and the palpi on each side are so nearly similar to those of *P. dactylus* as to require no observation; the siphonal sheath when extended is double the length of the shell. The liver is darker than in the last species.

P. CANDIDA, Linnæus.

P. candida, Brit. Moll. i. p. 117, pl. 4. f. 1, 2.

Animal conically elongated from the anterior end to the posterior axis of the cone. The body, sheath and mantle are a pale red-brown, but when divested of the epidermis, of the palest hyaline tinged with brown. The mantle as usual is closed, except the aperture for the foot, and being produced into a sheath that is proportionately shorter than in its congeners; the siphons are of the same length, and both are cirrhated at their orifices,—the only example in this respect that we know of amongst the *Pholades*; the branchial with

about twelve whitish-brown rays, of deeper tint towards the base, and between some of them one or two smaller, but not fimbriated; the anal has about eight short pale rays. Some authors describe papillæ on the tubes; our specimens only showed minute sand-like points, which we think are due to the epidermis. The foot is much narrower, more elongated and pointed than in any of its congeners, and fixed to the body by a compressed pedicle, of a pale hyaline in some animals, and flaky bluish-white in others. All the other organs exhibit no particular variation from those of *P. dactylus*.

P. CRISPATA, Linnæus.

P. crispata, Brit. Moll. i. p. 114, pl. 4. f. 3, 4, 5.

This *Pholas* does not inhabit the South Devon coasts. The *P. striata* of authors is exotic.

I have so fully entered on the boring qualities of the *Pholades* in the January Number of the 'Annals' for 1850 as to render further remarks unnecessary. The *Pholades* are generally excavators and inhabitants of rocks, chiefly the red sandstone on the South Devon coast, but the *P. dactylus* and *P. candida* often burrow and pass their existence in pure sand, at the back of the Warren and Cockle Sands at Exmouth, where the finest and most delicately sculptured individuals are found, surpassing in beauty the rock specimens.

Having concluded my remarks on the external organs of the *Pholades*, I shall now proceed to the anatomy of the *Pholas dactylus*, connecting with it the parts of the shell that relate to the hinge, cartilage, ligament, curved subumbonal apophyses, and other accessories: for reference, and to prevent confusion, I have distributed the matters to be considered into distinct sections.

The Hinge.

The hinge of the *Pholades* appears not to be well understood, and has not received the investigation that has been so liberally bestowed on the terebrating powers of the animal;

it is extraordinary, even in late malacological works, to find it described as obscure and rudimental, and M. Deshayes, in his comment on *Pholas* in the last edition of Lamarck, mentions the hinge as scarcely existing, and not being a 'véritable ligament'—how different from the fact! If there is a genus better provided than any other of the bivalves with ligamental appendages, it is *Pholas*.

The hinge of *Pholas dactylus* has very slight traces of denticular assistance; it nevertheless works *en charnière*, in a circumscribed space, to which it is confined by powerful ligaments, and though somewhat different in its component parts from the usual configuration, it does not in its functions materially differ from those of the ordinary bivalves; it has a strictly internal cartilage, which is laminar, of small volume, oval shape, and light yellow colour; it is fixed on the internal portion of the convexity of the valves, termed the hinge, which articulates, imbedded in the thin plates of the cartilage. The ligament succeeds; it consists of two parallel plates, between which is a considerable interspace of strong, close-set, white, elastic transverse threads, the one fixed more externally to the inner side of the reflected dorsal cellular excrescence, the other, below it, to the internal commissure of the two valves; thus forming a powerful ligament that allows them the usual movement of the ordinary hinge: on this is added a third ligamental apparatus, which may be termed accessorial, to increase the strength of the hinge, and which is formed by the reflection of the tough end of the mantle issuing between the anterior points of the valves in an elongated oval form, and covers the transverse threads of the outer layer of the ligament; it is firmly secured by throwing out filaments which enter the dorsal cells of each valve: this production of the mantle is further fortified by two thin, flexible, suboval testaceous plates, supported by a subtriangular rest; these appendages are exudations from the reflexed mantle. The posterior part of the valves, as is usual in elongated shells, has the common continuous membranous ligament produced by the protrusion of the edge of the mantle, with the addition, in this species, of a long thin linear testaceous plate; the use of

this posterior ligament is to assist in maintaining the valves in their natural position. It appears then that *Pholas* is iron-bound as to ligament, which, in it, is far more powerful in securing the valves than in the shells of any other group of the Acephala of similar fragility and tenuity.

The Muscular System.

It will now be convenient to notice the muscular system; and in the first place, that part of it connected with the shell. In this group of bivalves, the curved spatulate apophyses springing under the umbones have long excited the attention of naturalists, and the uses assigned to them as supports of the body, we believe to a certain extent to be correct; but they have other important functions that have not attracted sufficient notice. Before they are mentioned, it will facilitate their illustration if it is now stated, that though an anterior adductor muscle is spoken of by authors, there is not a trace of one in *Pholas dactylus*, and I believe all its congeners are also deprived of this organ.

There is only one adductor muscle in *Pholas*, not posteriorly situated, but very slightly post-medial: the fact of the absence of this organ anteriorly, I think I have ascertained beyond doubt: no muscle passes through the animal or embraces the mantle anteally, the tough and thickened margins of which are supported on both sides the shell and around the gape by long thin strap-shaped fillets thrown off from the medial adductor muscle, which, with that of the foot, may be considered as the great points of departure of all the principal muscles of the body.

Some authors contend that what I call the ligament, under the dorsally reflected mantle, is the anterior adductor: this idea cannot be supported, as independent of this strange position for an adductor muscle, the two layers of filaments are fixed, the one external to the other, with a space between them, to the *shell*, and not to the animal; therefore they are ligamental, and their action and reaction have the same effect as in the ordinary bivalve ligament.

The important functions of the crotchets under the beaks

claim particular notice, as much error has existed with respect to them: their utility originates from the two very strong muscular bands given off from the foot, which are fixed to their spatulate roughened terminations, and serve as *points d'appui* for its action in the work of excavation, without endangering or distressing the body. We have here a beautiful illustration of the resources of nature to accomplish what is necessary for the well-being of her creations; for if the foot was attached to the body as in the ordinary bivalves, without aid, the severe action of excavation would probably paralyse the animal and tear it from its natural position, which result is prevented by this admirable contrivance, and the body lies securely supported in the curvature of these appendages, whilst the movement of the foot is altogether maintained by working from the crotchets.

Nature has not given this animal an anterior adductor, because it is unnecessary, as it rarely expands the large gape by a separation of the valves; and when it does, the medial adductor and the limited action of the ligament suffice: the permanent gape is the equivalent for what in ordinary bivalves is effected by the opening and closing of the shell by the adductor muscles. The apophysary and pedal apparatus are not the substitutes for an anterior adductor muscle; for if they did act as such, their muscular powers must remain in quietude from the necessary contraction, and the excavating action would be destroyed: the two actions are completely antagonistic. The posterior part of the valves is only opened slightly to allow the issue of the basal portion of the branchial sheath, to assist by attrition in the enlargement of the posterior part of the chamber whilst the foot is operating in front.

The foot and pedicle, which in a living state appear almost hyaline, when they have become exsiccated, will be found to consist of a mass of longitudinal elastic fibres, the principal portion of which centre on the umbonal excrescences, and the remainder supply muscular threads to the anterior part of the body: the basal area of the foot is by far the most coriaceous portion.

Lamarck's Dimyal arrangement is strictly untenable, as the *Pholades*, having only a medial adductor, ought to be removed therefrom, and many of his *Monomyæ*, having two muscles, must be deposited therein. The medial adductor of the *Pholades* is a most influential organ; it is fixed to and is an integral component of the mantle at that point where it becomes the origin of the siphonal sheath, and adheres by its large subcircular flaps to each side of the valves, showing when removed two well-marked cicatrices: this muscle extends its influence to each extremity of the animal, as from it the mantellar marginal supports emanate; it also supplies the siphons with powerful retractors, and furnishes the tube into which the rectum discharges with a sphincter; it is the main support and connection of the animal with the posterior part of the shell; it likewise supplies the posteal parts of the body with the minor muscular threads; and finally it is the organ of a limited relaxation to allow the valves to be opened in concert with the cartilage and ligament for the issue of the basal portion of the branchial sheath, when it is required to assist in excavation, and of their closure to expel the water from the respiratory sac.

The whole mass of the branchial and anal tubes is a tissue of coriaceous muscles which are composed of layers of strong close-set longitudinal fibrous cords, crossed at right angles by minor ones, and at the posterior extremities they throw off the special annulated retractors of the terminal cirrhi of the branchial orifice, which appear each to have a minute sheath, and they also provide for the retraction of the anal orifice.—We have next to examine the nervous influences.

Nervous Influences.

The powerful and diffusively distributed muscles of this species would lead us to expect that the medullary masses would be of corresponding importance; this is not the case, as in *Pholas dactylus* I can only find two inconsiderable ganglia; the anterior one is the largest, consisting of a white pulpy mass, situated on the centre of the œsophagus just above the buccal aperture; from it two distinctly visible threads curve

anteriorly, the one giving filaments to the right, the other to the left palpum, from whence additional ramifications proceed to the anterior parts of the body, besides supplying the muscles of the foot. The posterior ganglion is situated between the heart and the anus, and is connected with the anterior one by two close, parallel, dorsal, very minute longitudinal threads that are seen without difficulty, and cannot well be mistaken for veins; the minor mass furnishes threads to the adductor muscle, and sends to the ovarium and muscles of the belly appropriate filaments. This is all that I have been able to observe of the nervous system, and collect from it, that however insignificant the ganglionic masses may appear, their effects on the muscles prove that the potentiality of their influences is not impaired by the minuteness of the hair-like threads which are the conductors of the subtle fluid that excites their action.

The Digestive Organs.

We commence with the mouth, situate immediately above the connecting labium of the palpi; it is rather a large transverse orifice, and leads directly into the simple œsophagus, which proceeds with a portion of the liver on each side of it through the anterior part of the dorsal range into a small oval stomach, the base of which is enveloped by the light green granular liver which pours the bile into its rigid coat by several ducts; its cavity is almost filled up with a folded plate, which I call the gizzard or stomachal attritor, and authors the tricuspid membrane, which is erroneously, as I think, considered by some malacologists an agent to regulate the entrance of the bile from the liver. I think this idea cannot be sustained, as besides the stomach being provided with bile ducts, one of the axes of the tricuspid corneous plate is fixed at the cardiac orifice of the stomach, and receives the animalculæ as they descend the œsophagus; and after trituration by the gizzard, which is worked by the elastic hyaline stylet, they pass through the other axis of the tricuspid membrane, which is inserted in the pyloric orifice into the intestine. I have preparations showing the gizzard in the stomach with its

posterior end united to the intestine, and attached by the middle to the hyaline stylet.

This singular organ, so well known to exist, I believe, in all bivalves, has caused some difference of opinion as to its use; but I think when all the incidents attached to it have been mentioned, they, in conjunction with the position in the stomach of the tricuspid organ, can lead to no other conclusion than that the apparatus is a gizzard worked by the foot and elastic stylet to comminute the food, and is analogous to the gizzard in many of the Gasteropoda. The stylet is for the basal half cylindrical, and tapers from thence to the stomach, where it makes a loop, and is fixed by a filamentary muscle to the gizzard or tricuspid membrane; its colour is hyaline milk-white, and in certain lights reflects the metallic hues; the working point of support is the centre of the basal part of the foot, through the pedicle of which it proceeds obliquely to the stomach, guarded by a sheath which appears to secrete a lubricating fluid, probably having its source from the liver, through the centre of which it passes to its junction with the corneous attritor; it is eminently elastic, formed of a suite of circular lines; it is impervious. I have submitted it to every sectional form, but the only departure from homogeneity are the fine circular elastic fibres; in the species we now describe it is fixed by a short muscle to the bottom of the foot; in *P. parva* it appears to rest, free. At one time I thought the stylet might be the vehicle of a solvent fluid from the stomach, but its impermeability negatives this idea; and if there is a connection with the foot from the stomach, it must be by the sides of the walls of its sheath; in that case a solvent would neutralize the lubricity so necessary to its action, as a spring for the gizzard; besides, the most careful examination of the external and internal surfaces of the foot shows no connection between them, or orifice for the issue of a solvent. No adjuvant powers of sight have enabled me, in this species, to discover the pore which is said to admit water to the foot of many of the bivalves, or to expel it if received from the stomach.

I now return to the intestine, which we left united to the

posterior end of the tricuspid membrane; as soon as it is clear of the pylorus, it makes a double and plunges deeply into the body, nearly to the foot, through the folds of the liver, and then ascends to the dorsal region, to near the point from whence it commenced the circumvolution; it then proceeds under the peritoneum or membrane enveloping the liver and stomach to the pericardium, which it pierces, and passes in a straight line, embraced by the ventricle and auricles, to its termination in the anal tube.

The Circulation and the Respiratory Organs.

The circulation is complete; that is, there is an aortic action, and a venous reflux of the blood for aëration to the pulmonary apparatus. The respiration is effected by a pair of very long membranous narrow symmetrical laminæ on each side of the body, composed of a vascular network, fixed under the mantle to the dorsal range, accompanied also on each side by a pair of palpi. On leaving the body the four branchiæ without an intermediate substance run together tapering to their termination at about ½ an inch from the extremity of the branchial orifice; they are firmly fixed the whole length by their bases, from the point they leave the body to the membrane which separates the anal from the branchial cavity, cutting off all communication between the two siphons; consequently the water must be received and ejected through the branchial siphon, or by the pedal orifice, in the bivalves with closed mantles, as is the case with the *Pholades*, and probably with other families of the same structure in which the branchial and anal tubes are separated their entire length by a divisional membrane.

The discovery of this circumstance is so important as regards the disputed point, how the branchiæ receive the ambient element, that I have used every means to test it, by dissection, by all the modifications of experiment, and particularly by mercurial injections; this last mode I have used very successfully, as the following operations will show. First, I threw into the anal siphon a column of mercury that completely filled the cavity, and on applying further pressure, regurgita-

tion ensued, but not a particle of the mineral found a passage to the branchial vault; this result occurred in many specimens, and though the pressure was often considerable before regurgitation was allowed to take place, still the branchial division of the mantle remained free from the quicksilver. In one experiment the fluid appeared in the lateral tissues; this I attribute to a lesion of the dorsal lateral membranes. 2ndly, I found that when there was not the slightest solution of continuity in the fine membrane on which the branchial vessels are fixed on one side, and the interweavings and traceries on the other, which form the roof of the anal siphon, the application of the mercury to that tube gradually filled the whole range of the branchial vessels, which exhibited a very elegant appearance, but no fluid escaped from them into the branchial sac. 3rdly, I repeated many times the first experiment with the view of endeavouring to find a passage through the rectum and intestine on the dorsal range that is embraced by the heart, but without success; if I had succeeded, it would have been impossible to arrive at the stomach and mouth, as the intestine plunges into the body coasting the foot, at which point it is of larger diameter, and always filled with a compacted mass of sand which effectually stops up the passage: this part of the intestine around the foot, from its difficulty and the hardness of the fæcal matters, seems analogous to the ascending portion of the colon in man.

In all these attempts either regurgitation ensued, or the continual pressure of the mercurial column caused lesions.

This impossibility to pass anything into the rectum probably arises from its sphincter, or one in the anal tube, as the stoppage always occurred at that point where it empties into it.

4thly, On applying the mercury through the mouth and œsophagus the stomach was readily filled; but as soon as the pylorus was passed, a stoppage not to be removed occurred, from the duodenum being, like the colon in the last case, filled with sand; we may therefore conclude that water can never enter the stomach of bivalves from the anal tube.

The spaces lining the roof of the anal siphon consist of four longitudinal rows; the two middle ones are the largest, and form transverse parallelogrammic figures, whilst the other two, one on each side, are smaller subquadrangular areas. I can conceive no other use for these crypts, in such families as have them, than as depositaries for the ova; if so, the oviducts of course communicate with them, and the ova probably remain there some time after fecundation; and the final ejection, in bivalves of this structure, can only take place from the anal tube. It is probable that the principal use of the anal conduit in the bivalves, in which the branchial cavity is completely cut off from the anal one, is to receive the rejectamenta, supply water to the ova during their maturation, and ultimately to eject them *.

It is necessary to state that these experiments require much patience and attention, and some delicacy of manipulation, to arrive at sound results: it is very material not to use specimens with accidental lesions, or those made in removing the animal from the shell, which operation, from the obstruction of the crotchets, cannot be effected without some practice and dexterity.

The result of the 1st and 3rd experiments would appear to demonstrate the non-communication between the branchial and anal siphons in the *Pholades*; this fact being established, they will not be the exceptions; but it is probable that the *Myadæ, Solenidæ, Lutrariæ*, &c. have a similar configuration of the branchial apparatus; and though the *Veneres, Cardia*, and other open-mantle bivalves have the character of their branchial sacs different from those of the *Pholades*, in not having the siphons completely separated, but more or less confluent, the possibility of branchial currents must be admitted. Still, as it has been shown that in the *Pholades* the water cannot be received and discharged otherwise than through the branchial aperture, or from the pedal orifice, it

* Since this was written, doubts have arisen whether the ova after exclusion are deposited for a time in the crypts of the anal tube, or in the branchiæ; we have never discovered any out of the ovarium.—Exmouth, 1853.

is clear that regular separate currents by cilia cannot exist between the two siphons, so as to make one the inhalant, and the other the exhalant canal; and if there is any truth in analogy, every presumption authorizes us to conclude, that the same action of the reception and discharge of the water through the branchial siphon and pedal or ventral opening prevails in the open-mantle bivalves, the *Veneres, Cardia,* &c., wherein the branchial sac is posteriorly divided into two, not separated, but confluent siphons at their bases, being only more or less divided towards their terminal portions by an internal septum, so that they must be considered in conjunction, and as one siphon, for branchial purposes.

If therefore it be established beyond all reasonable doubt, that there is no communication between the anal and branchial siphons in *Pholas,* there is an end to the doctrine of separate branchial currents by cilia; for if this is impossible in one family of the same class, we have a right analogically, and agreeably to the axiom "ex uno disce omnes," to consider that all are in a similar category as to the mode of admission of the water to the branchiæ, whatever may be the differences in certain classes in the disposition and structure of the siphonal apparatus.

Having arrived at this conclusion, I will, though it is almost unnecessary in corroboration of it, make a few additional remarks. It is well known that muscles are often hung up high in the crevices of rocks, some of them above the level of the ordinary tides, where my dredger says that they remain suspended throughout the year, and can only for a few days in each month, at spring tides, receive the water: this condition may occur for about two hours in 75 days out of the 365; yet when any of these animals are opened, the cilia, under the microscope, will always be seen in action, beating, subdividing, and eliminating the air from the moisture. In this case, for near three-quarters of the year, the creation of branchial currents is impossible; they cannot be produced from nothing.

It appears then, whether the cilia be within the possibility of assisting in the creation of branchial currents or not, their

action never ceases whilst moisture remains in the shells, and I think it must be considered as settled, that there is no community between the cilia and what are called branchial currents. I have at Exmouth repeated all the experiments with the mercury on fresh flexible animals; the first were performed with rigid specimens from spirit; the results are most satisfactory, and I think entitle me to state with confidence, that in *Pholas* there is no communication between the branchial and anal siphons.

Since the above observations were written, I am enabled to state, after a prolonged and anxious examination of fifty living *Pholades*, under all the phases of experiment, that nine-tenths, if not all the water to bathe the branchiæ is admitted at the *pedal* gape, and ejected *only* by the *branchial siphon*; the anal one *alone inhales* water and discharges it; and in the closed-mantle *Solenidæ*, *Myadæ*, *Lutrariæ*, &c., as well as in the open-mantle *Veneres*, *Cardia*, &c., the water is only admitted into the branchial vault at the pedal or ventral aperture by the simple opening of the valves, and ejected according to the structure of their respective sacs, either by the branchial issue alone, as in the *Pholades*, &c., or, as in the *Veneres*, *Cardia*, &c., by the two confluent orifices, which are in fact but one branchial conduit.

This discovery and attendant results will finally, I hope, dispose of the complicated scheme of some authors, of the reception and discharge of the water for branchial purposes by cilia and separate siphonal ducts, as it shows what I have always advocated, that nature gives access to the water for the respiratory apparatus by the simple opening of the valves, and causes it to be discharged, when effete, by their closure at the posterior siphonal issue, as well as by the pedal opening and ventral scissions of the mantle. It is therefore I think satisfactorily proved, that the doctrine of separate currents by cilia, and that the inhalant is always kept distinct from the exhalant current and admitted by a separate aperture from that by which the latter is expelled, or in other words, that the water is imbibed by the branchial siphon and discharged from the anal, is absolutely untenable.

The important discovery I have just related was made manifest in the simplest manner. On taking up an animal, the siphons of which were largely inflated, I observed that the great mass of water was poured out from the branchial tube, and only a small quantity from the anal one; on replacing the animal in water, I was surprised, instead of seeing, as I expected, the water flow up the branchial canal, to observe a powerful column, through the tenuity of the membrane, pass rapidly from the pedal opening, in consequence of the relaxation of the mantle around the pedal gape, and fill the branchial vault. This very decisive proof how the water reaches the branchiæ induced me to vary the experiment. I placed the animal with the tubes entirely in the water, and the pedal gape out of it; very little fluid entered the branchial sac, the anal siphon alone imbibed a portion; and on holding the animal with the siphons downward, scarcely any water issued from the branchial one, and only a little from the anal; but as soon as I suffered the pedal gape to reach the water, a column was instantly seen to fill it as before.

I do not mean to say that if the pedal aperture is kept out of the water, some fluid may not be imbibed by the branchial tube; nature will supply its wants by other channels if deprived of the accustomed ones. I only insist on the position that the usual canal for the entry of the main body of water for the use of the branchiæ in all bivalves is by the pedal and ventral apertures; that the exit is by both the branchial and pedal fissures of the mantle; that these actions are accomplished agreeably to the wants and will of the animal at uncertain intervals by the simple opening and closure of the valves, and that what are called currents by cilia do not exist. I cannot help again observing on this simple solution of a disputed point;—I may call it as simple a one as that of Columbus, when he showed how the egg may be made to stand on its apices; and yet it is quite decisive of the desired point, how the water is admitted to the branchiæ.

The Secretory Organs.

Under this head, as I propose to offer at a future time some

observations on the anatomy of the Lamellibranchiata, I will only at present mention the veins and glands which I think produce the cartilage and ligament. On carefully opening the lateral cavities on each side the anterior dorsal range, a fasciculus of veins may be seen deposited therein, some of which I have traced to the liver; and it is probable that the inspissated fluid thrown off by them is specially applicable to the formation of the cartilage and internal portion of the ligament, as I have found their excretory ducts to be spongy masses that send forth the viscous humour distilled from the veins on the internal convex circular areas in which the valves articulate; and a proof of one at least of the true uses of the excretory apparatus is, that in *Pholas dactylus* the fluid is of a light brown or drab, and it produces two thin cartilaginous plates of those colours, whilst in *P. parva* the colour is as dark as tar, and the plates of the cartilage correspond with it. It is probable the coarser parts of this secretion are separated from the concentrated cartilaginous matter, and form the interior layers of the ligament, the mantle only producing the external skin. It is reasonable to suppose that all bivalves have these secreting organs; and it will be desirable to ascertain if such shells as the *Mactræ*, *Myæ*, *Lutrariæ*, &c., which have internal cartilages of considerable volume, have the excretory and secretory organs correspondently developed as in the *Pholades*; and if in those genera that have external cartilages, there is any variation of structure.

The Reproductive Organs.

The Acephala are hermaphrodites without congression, and as it is termed, they suffice for themselves; but this fact must not be understood ideally, as these animals have distinct visible organs, the union of which, within themselves, produces the male and female influences. I hesitate to concur in the statement of some authors, that the sexes are distinct in the bivalves. I think it is probable that this idea has arisen from the animals being examined at different periods of the year. In the genial months, the ovaria, and the virile membranous pouches, are distended and fully developed; but in the winter

season, when all nature flags, and takes repose after the exhaustions of the summer, and when even the influences of the "Æneadum Genetrix" are softened down, then the ovaria and the pyriform virile membranes become obsolete: these two very different states may have contributed to produce erroneous conclusions. We must, as I have elsewhere observed, not forget the precept,

"Ætheris et terræ genitabile quærere tempus."

I do not mention that I have quoted this line a second time, as an apology for the repetition; on the contrary, I mean to mark the great importance in which it was held by the illustrious author, who has in his work repeatedly used it or its equivalent.

The ovarium of *P. dactylus* is a conical organ, amalgamated with the lower part of the body, having a pointed apex. Though I applied the quicksilver, I did not satisfactorily make out the oviducts; they do not appear to be at the apex of the ovarium, and I am inclined to think that they are situate at the junction of the body with that organ. In many bivalves it is considered that the ova, on issuing from their receptacles, are at once committed to the protection of nature. This idea is mainly correct, but in certain species, for example in the *Kelliadæ*, &c., the ova, after fecundation and exclusion from the ovarium, are for some time committed to the protection of the parent before final ejection; in *Anodon* and the *Mytili*, they are transferred to the branchial laminæ for maturation. In the *Pholades*, we believe the ova pass at once from the ovarium into their native element.

Since the above observations were written, Messrs. Alder and Hancock have dissented from my theory; I replied by the following letter:—

To the Editors of the Annals of Natural History.

GENTLEMEN, Exmouth, September 1853.

I request permission to reply to Messrs. Alder and Hancock's comments in the 'Annals of Natural History,' vol. viii.

p. 370. pl. 15. N. S., on my branchial theory, which appeared in a paper on the *Pholadidæ* in vol. vi. p. 313 of that publication. I was so engaged last year in the examination of a splendid harvest of rare animals, that I had no time to consider their remarks, but having now an unlimited supply of *Pholades*, I will endeavour to acquit myself of my engagements with these gentlemen.

They commence by quoting parts of my theory, and say that I announce "that $\frac{9}{10}$ths, if not all, the branchial water is admitted by the pedal gape." On this point they observe—

"Let us for a moment consider what would be the consequence of Mr. Clark's supposition, that these animals obtain water only by the pedal gape. Nearly all of them pass their lives buried in sand or mud, or immured in solid stone, with only a small aperture externally, the pedal opening being beneath, and the siphonal tubes in communication with the sea. Yet Mr. Clark would have these animals receive only the small quantity of water charged with sand and mud that finds its way to the bottom of the cavity, rather than draw their supply from the pure element on the surface, by means of their long siphons."

To this quotation I reply, that a fresh and very extended examination of four species of the *Pholades* fully supports me in maintaining all my positions, and I think I shall demonstrate that Messrs. Alder and Hancock's system of branchial currents is erroneous. The only correction I have to make is, that I have clearly ascertained that the branchial, like the anal siphon, is both inhalant and exhalant.

With respect to their observations on the habits of the *Pholades*, it is only necessary to admit, that these animals often inhabit sand and shingle, mixed with clay, and are not always imbedded in hard rock. But we contend that the cavities in which they dwell afford sufficient passage for the sea-water, and the areas of their habitats are saturated therewith, as when the tide withdraws, much of its waters is retained by the various strata, which by filtration reaches the burrows in a pure state, and not "charged with sand and mud."

Continual watchings for months of multitudes of these animals prove beyond doubt that the water is not only copiously received at the pedal gape or aperture, but is often expelled with as much force, and with a similar formed jet, as from the branchial siphon; and my dredger, who during the last fifty years has excavated more *Pholades* than any man in existence, says, that he continually sees the water expelled from the pedal gape. This is an important fact in corroboration of my theory, as an in- and ex-current is established pedally in combination with the branchial siphon.

I will now mention a decisive proof that nature, in all the bivalves, intends the water, under certain conditions, to be received and expelled by the pedal gape or aperture. When the gape of the *Pholas papyracea* is closed, by being domed by the animal, a large ovally dilatable fissure is always left for the water in the connecting membrane of the laminæ of the dome, in its centre, to correspond with the gape that has been rendered ineffective. And in the linear Solens, in which, from the quality of the foot and its singular position, the water cannot well enter pedally, a similar aperture is also left in the membrane of the connecting valves. In the *Myæ* and other bivalves the water has access through the ventral and pedal apertures. Thus we learn from these examples that when nature has denied the ordinary pedal entry and exit for the fluid, she always supplies a compensation.

The periodic entry and reflux of the branchial water present two distinct characters; the one being regular, the other more uncertain. With respect to the first, place a dozen *Pholades* and as many *Pullastra pullastra*, or *P. decussata*, in a dish of sea-water: it will be seen that each has a regular periodic action, the *Veneres* usually from one to two minutes, and the *Pholades* three to four, until a change of circumstances induces a new disposition. The entry and issue of the fluid, in conjunction with the pedal gape and aperture, are thus performed:—the animal simultaneously closes the orifices of both siphons, which after a short pause are again opened; the effete water flows from both, and fresh is received. But independent of these silent though very visible operations, there is about

every five minutes a powerful and copious jet from both tubes, sometimes simultaneously, at others at intervals, and that from the branchial tube in the *Pholades* is almost always accompanied by a strong ejection from the pedal gape, and also in the *Veneres* from the pedal aperture, though from the absence of a gape in their shells it is not so visible. The periodic times of the in- and out-flux, of whichever character it may be, as the animal becomes exhausted, are more and more prolonged; they are only in vigour for twelve hours.

What is the object of these copious and regular receptions and expulsions of water? Will not every reasonable person acknowledge that they can only serve for branchial purposes —the receptions, to administer water to the gill-laminæ, and the expulsions to remove it when effete by the contraction of the adductors of the valves and siphonal retractors? In corroboration of the above, I particularly refer to the Rev. James Bulwer's account of the *Isocardia cor*, published in the 'Zoological Journal,' vol. ii. p. 258. Messrs. Alder and Hancock cannot controvert these facts, and therefore in relation to my theory say, "This is, however, a special case having nothing to do with the regular branchial currents, as has before been pointed out to Mr. Clark."

My opponents may find their special case a general law, and their system of regular branchial currents an illusion.

They, having discovered that no ascertained communication —[this is a condition of my theory]—existed between the branchial and anal chambers, thus express the fact:—"We certainly find no opening between the foot and the gills, nor between the gills and the mantle;" and in consequence of their favourite doctrine being in jeopardy, they "found it necessary to make a careful examination of the anatomical structure of these animals," and have informed us of the discovery of a channel, by declaring the gill-laminæ and their interbranchial tubes permeable, on which—to them a most important fact, if true—they emphatically observe, "Thus in an instant the secret was explained; the currents communicate through minute openings in the laminæ of the gill-plates."

I think these gentlemen have formed an erroneous conclusion: I cannot accord with the monstrous position that the impure branchial water, deprived of its oxygen by the cilia, and of the alimentary matters by the *palpi* of the animal, is sent by filtration, even if pores existed, through the gill-laminæ and interbranchial tubes, which are the supports of the delicate blood-vessels for discharge at the anal siphon.

As the capacity of the branchial chamber is at least three times greater than the anal, Messrs. Alder and Hancock must admit that two-thirds of its fluid is expelled agreeably to my theory; it is therefore difficult to conceive a plausible reason why a part of the effete water, only one-third, should be got rid of by an issue, termed by them a branchial current. The sustentation and aëration being unquestionably effected in the branchial vault, we may inquire, what is the object of this partial labyrinthine exit for the water instead of its being wholly ejected by the pedal aperture and branchial siphon, at which it entered, agreeably to the simple laws of nature?

In connection with these views, I state a fact that may have some weight even with the sceptical. The longitudinal retractors and transverse muscles of the siphons are of very great power; the office of the latter is to diminish the calibre of the tubes, that, in conjunction with the former, they may effect a more powerful expulsion of the impure fluid. As proof, if a dozen *Pholas dactylus* are placed in a large dish of sea-water, they will cause so great an ejection from the siphons, not from the effect of sudden disturbance or being startled, but of regular periodical emissions, as to cover the table several times during the twelve hours of the day and also throughout the quietude of the night: assuredly this circumstance serves to prove that the impure water is thus expelled, and that no part of it permeates the interbranchial tubes.

However, it still appears that Messrs. Alder and Hancock insist on a regular in-current by the branchial siphon, and an ex-current from the anal, effected by *cilia*, for the use of the respiratory apparatus; these are, as I think, strange and

impotent motor agents. I have in a former paper expressed a belief that the function of the cilia is to beat and subdivide the water, that the oxygen may be the more easily extracted. I must now observe that all the testaceous Mollusca have many parts of their bodies clothed with cilia, which show their action in a similar manner to the Bivalves. What then, in them, are the functions of these appendages? May we not reasonably conclude, the same as in the Bivalves, to extract air from the water not only for their branchiæ, but perhaps to pass the vital fluid through the pores of the body. One can hardly suppose that in either group their duty is mechanically to create currents, when a more simple, visible, and effective plan exists; I therefore think the view is untenable, that they effect the in- and out-flux of water in the anal and branchial chambers. I believe a simple hydrostatic law provides for this operation in all the Bivalves by a vacuum being formed by the contraction of the valves in the expulsion of the effete water, and that on opening them and relaxing the siphonal orifices to take in a fresh supply the vacuum ceases.

The action of the cilia is local. That they produce currents or rather eddies on the gill-laminæ and different parts of the body of the Gasteropoda cannot be doubted; these result from every stroke of each that causes a displacement of fluid which instantly reverts to its level, but they are not the locomotive agents of the entrance or exit of the branchial water; they are strictly particular, having no determinate line of operation, and act indiscriminately from every pole. As presumptive proof, examine an oyster or a muscle from a provincial stall a few days after they are received, when the cilia under the microscope will be found in full action as if just taken from the sea, and will continue so as long as moisture remains. In this case these species, even if they had siphons, could not produce in- and out-currents by separate ducts, from non-access to water; we are, therefore, bound to give the preference to the idea that their functions are to eliminate the oxygen. I may observe, that cilia are attached to the different epithelia in all animals, from the monad to man. The inconsistency of such a motive power will be apparent

from the consideration that the cilia must act antagonistically from opposite points; one set to work the water in branchially, and another to expel it through the anal duct after percolating the gill-laminæ and interbranchial tubes. I shall recur to the cilia, and expect to prove that the new scheme of communication between the two siphons is very problematical, I may say impracticable.

Messrs. Alder and Hancock go on to say, that any one may convince himself of the existence of a branchial in-current and an anal ex-current, by placing a *Pholas* "in a glass of sea-water, and then by gently adding a little fresh, slightly charged with floating particles," the two actions may be perceived. I admit, by this process, that currents will ensue, as the invigorating fresh element causes the animal to expel that which has become effete and take in a new supply; but as I have, under every condition of experiment, examined multitudes of these creatures, I am bound to declare that the currents have no *continuous* regularity: and I think the mode of testing their presence by means of water charged with buoyant particles is fallacious; these only float on the surface, and are subject to many perturbations and deceptions arising from depth of water, currents of air, the position of the animal, whether on the ventral or dorsal surface, by its will and humour, state of exhaustion, and an unnatural confinement. My repeated examinations show that the particles are whirled in all directions; sometimes they pass into the branchial chamber, at others none will enter: capricious gyrations, whether arising from the action of the animal or other natural causes, are their ruling character. With respect to the anal siphon, the floating particles are certainly repelled from its orifice in a somewhat regular and continuous manner, being only interrupted by the periodic reception of fluid to supply the exhaustions. The frequent repulsions of particles from the anal orifice have been construed by Messrs. Alder and Hancock to arise from the percolation of water from the branchial vault through the gill-laminæ and interbranchial tubes to an issue at the anal siphon, produced by the agency of cilia. I think it will appear that this complicated operation

will meet with insurmountable difficulties, and though I admit the anal outflow, I protest against its being considered of branchial origin and regular; the regularity is fallacious, though most naturalists appear to have adopted that idea, without perhaps sufficient examination, and others have been careless in their observations. But the diligent observer of cause and effect will perceive that there is as much water inhaled as expelled by the anal siphon, and that its fluctuation in the branchial chamber, produced by the contraction and dilatation of the four gill-plates, which can often be seen by a lens through the orifice of a large *P. dactylus*, aided by the respiratory circulation, causes a pressure and an impulse on the interbranchial tubes; these, as before shown, are filled every two to four minutes by a reception of water anally, which after performing its function, of whatever nature it may be, is thus for a similar period made to reflow into the anal cavity, and from thence is discharged by an insensible contraction of the siphonal muscles until the exhaustion of the fluid: this is very evident by the failure of the current, which only recovers its full action on the periodic renewal of the water. I have thus, perhaps, explained the mystery of the so-called branchial current.

It is problematical what are the precise functions of the water that is received into the interbranchial tubes and anal vault; I have hereafter alluded to some of them conjecturally, and for the present will only observe, that as this tube acts as a conduit to the contents of the rectum, one probable use of the water is to break down and remove the dejections; and it would indeed be strange if it had no other entry, except from the branchial vault by the devious route of filtration through the interbranchial canals.

In further support of the view that the anal ex-current is not the effect of a percolation of liquid through the gill-laminæ, I will for a moment digress, and relate a short incidental experiment. As the anal siphon is somewhat longer than the branchial, it is easy to subject the latter to the influence of the water and isolate the former; it resulted, that whilst the water flowed into the branchial cavity, none, in an

hour's constant observation under the lens, issued from the anal siphon, a sufficient proof of the non-communication of the two; but as soon as the anal siphon was allowed to reach the water and obtain a supply, the current recommenced.

I now come to another experiment from which Messrs. Alder and Hancock conclusively infer the connection of the siphonal currents. They state, "that the nosle of a blowpipe charged with a coloured fluid was placed at the inhalant orifice of a *Pholas*, and immediately a quantity was drawn into the animal. Watching carefully the result, we had soon the satisfaction of beholding a blue-stained stream issue from the exhalant orifice."

To this I observe, that having tried the experiment again and again, failure always occurred; as the animal, after receiving the coloured fluid, which was applied without difficulty, in general immediately discharged it by the pedal gape, or by the branchial aperture overwhelming with coloured matter both tubes, the orifices of which, from their inflection by the animal, were so retracted and blended together as to be undiscoverable; of course, any issue of liquid from a particular tube was undistinguishable. When, in any example, the fluid, which was coloured by archil, remained a little time without expulsion, I opened the branchial cavity to see if the gill-laminæ and interbranchial tubes showed any increased inflation or colour from the filtration of the injection, but no unusual appearance presented itself. I also opened the anal vault and collected with a camel's-hair brush as much of the moisture as possible; this was applied to a very small quantity of distilled water, but no trace of colour appeared; we may then presume that none of the injection had passed from one siphon to the other. But when the coloured fluid was administered anally, all the interbranchial tubes were at once filled and remained inflated more than an hour, representing minute well-filled hoses, which bore the pressure of a delicate wooden stylet, and exhibited the fluctuations of the liquid, which, on its removal, instantly reverted to the points of displacement, without any escape into the branchial chamber. We may therefore conclude, that the interbranchial tubes are

impervious tissues, and are supplied through the orifices of the crypts from the water sucked in by the anal siphon; and one of their uses is probably, by being filled, to afford a sufficient tension to the network of the blood-vessels that they may the better receive the action of the cilia: they may also possibly be the receptacles for the maturation of the ova, agreeably to the opinions of some naturalists; but in the multitudes I have examined I cannot corroborate this view, as during the months of May, June and July I failed to see any deposit of ova either on the gill-laminæ, or within the interlaminar cavities, or in the crypts of the anal vault; still the "*genitabile tempus*" may be later; nevertheless the ovaria were well filled with germs of various sizes. Under all the circumstances of this experiment, I think, though it may not be impracticable, that it cannot be depended on even if the gill-laminæ are permeable; but as I confidently believe no communication exists through them, I must conclude that these gentlemen were mistaken in supposing they had detected an issue of coloured fluid from the branchial vault through their exhalant siphon.

I have now to consider the principal experiment, which Messrs. Alder and Hancock think will settle the disputed problem of in- and ex-currents in the Bivalves, produced by the action of cilia through separate siphons. They say,—

"But a simple experiment will at once solve this difficulty. Having killed a specimen of *Pholas crispata* with the siphonal tubes contracted as little as possible, and having placed it in diluted spirit a few hours to render the tissues firm without hardening them too much, we had again recourse to the blowpipe, charged as formerly with coloured fluid. The specimen was opened down the ventral margin, exposing to view the whole of the gills stretched along the roof of the branchial cavity. The nosle of the blowpipe was passed into the anal siphon, and on removing the finger from the top of the pipe, the contained fluid immediately filled the anal chamber behind the gills, and then passing at once down the tubes between the laminæ of the gills, issued through ten thousand pores, and dyed the water in the branchial chamber. Thus in an instant the secret was explained;—the currents com-

municate through minute openings in the laminæ of the gill-plates.

"Having thus satisfied ourselves of this fact, we next directed our attention to the structure of the gills. Accordingly, the anal chamber was laid open, and its ventral wall was seen to exhibit four longitudinal rows of large orifices. These four rows of orifices, already well known to anatomists, correspond to the attached margins of the four gill-plates, which hang from the roof or dorsal membrane of the branchial chamber; this membrane being the ventral wall of the anal chamber,—the membrane, in fact, which divides the chambers.

"These orifices lead into wide tubes which pass between the two laminæ forming each gill-plate. These interbranchial tubes lie contiguous and parallel to each other, and extend the full width of the gill, being bifid within its free margin. Thus it is evident that the tubes within the gill-plates communicate freely with the anal chamber. The laminæ forming the walls of these tubes were now examined through the microscope, when the whole was observed to present a regularly reticulated structure composed of blood-vessels; those passing transversely being the stronger and more prominent. The longitudinal vessels, rather far apart from each other, form the meshes into parallelograms. These meshes are open spaces, fringed internally with a narrow membrane and active vibratile cilia. The two vascular laminæ forming the gill-plate are really sieves to separate suspended molecules from the surrounding medium on the passage of the water from the branchial to the anal chamber;—an apparatus of the most exquisite beauty and perfect adaptation to the desired end.

"We cannot understand how this beautiful structure escaped detection by the mercurial injection of Mr. Clark."

I at once dispose of the last remark to save trouble in my counter-statement. If these gentlemen had read a little more attentively, they would have seen, in the paper on which they have passed their strictures, that Mr. Clark states, "The application of the mercury to that tube gradually filled the entire range of the branchial vessels, which exhibited a very elegant

appearance, but no fluid escaped from them into the branchial sac."

It is proper to state, that the *Pholas crispata* is the species that has furnished my controversialists with their remarks on my branchial theory, which is illustrated chiefly by the *P. dactylus*. I am not aware that this circumstance is of much moment, as we may safely conclude that the gills of all the *Pholades* have in essentials the same character. But I ought to mention, that the framework of the respiratory apparatus in some tribes of the Bivalves presents a very different arrangement. For example, there are several British families, whose species I have seen alive, and which fortunately can be obtained, that have a peculiar branchial construction, which appears as to *general* configuration closely analogous to that lately described in the 'Annals' to exist in the *Chamostrea albida* and *Myochama anomioides* of authors, but the *particular* parts of the mechanism in my species do not accord; I think the narrow reticulated ribands on the external surface are not permeable, and do not lie on apertures that communicate with the interbranchial tubes. I refrain, at present, from extending these remarks; but I shall be prepared with some comparative notes on certain species that have only a single complete gill-lamina and a rudimentary one on each side of the body, which seem to me to differ essentially in structure from the descriptions that have been promulgated on the composition of the branchial mechanism of the species that have been alluded to.

I now enter on the counter-statement to the last quotation, and beg to observe, that Messrs. Alder and Hancock, in the explanatory sketch of their *Pholas crispata*, 'Annals,' pl. 15, vol. viii. N.S., give a very intelligible outline of their theory. Though entirely dissenting from it, I cannot but admire the ingenious delineation, particularly fig. 3, of the gill-laminæ, showing the aspect of the meshes; it has, however, one fault —it exhibits them *all* with symmetrical longitudinal fissures called "orifices," which I think are ruptures of the membrane of each mesh, not one of which exists naturally in the three species I have examined.

Since May 1853 I have often performed "the simple experiment" detailed by Messrs. Alder and Hancock in the third paragraph of their paper, p. 374; it is by far the most important of the series, as the problem of communication, with them, between the anal and branchial siphons, depends on it. By the injections of more than 200 *Pholades* with mercury and coloured fluids, the invariable result has been my inability, as in the first experiments in 1850, to pass the fluids through the anal chamber further than to fill all the interbranchial tubes; but I always found the gill-laminæ, which form their walls, impervious, instead of allowing liquid to issue "from 10,000 pores." It is necessary to state that the numerous interlaminar canals that compose the divisions of the gill-plates are nearly parallel, and hang vertically from the dorsal line, ranging at equidistances throughout a great part of the extent of each branchial plate, and by sutural lines of junction cut off the communication between each tube.

I will now enter a little more into detail on some points in connection with the branchial laminæ, by describing the appearance of the areas of the parallelograms under repeated examinations by transmitted light, and also as opake objects, rendered so by the injection of mercury.

In a full-grown *Pholas dactylus*, the surfaces of each gill-lamina together comprise an extent of about a square inch, every one-tenth of which contains 400 oblong subquadrangular spaces, or 40,000 in each plate, forming a total in the four gills of 160,000; this admeasurement and enumeration may not be very far from the truth. In each parallelogram, besides a general suboval depression, there are within it from five to twenty or more shallow excavations of various size and shape, but there is no ruling symmetrical fissure as delineated in Messrs. Alder and Hancock's fig. 3. Each area shows a plain, a pitted, and a mammillated or traceried surface, detected by the action of the microscopic foci. We will start from the plain surface, in which there is certainly no perforation: the fine adjustment of the instrument measures the depth of the depressions, and by another movement shows the character of the minute points, thus proving that no fissure or aperture

exists; as when there is really an imperfection in the membrane it cannot thus be resolved, but under every phase of the instrument the hiatus of a solution of continuity is seen. The shallow depressions are the uncovered patches of the membranous base of the scales or epithelium, incident to all the Mollusca; from them the numerous vibratile cilia spring, which present the most discordant and particular motions that operate from every point; sometimes they appear as if each entire pit was whirled on a vertical axis, at others a compact mass of strands dilates and contracts like the heart, then a fasciculus of cilia is seen beating the water with irregularity; sometimes only a single cirrhus is raised in quick succession, like a hammer in a mechanic's hand; but it is impossible to describe all the varieties of motion. In a fresh animal, the action and strokes exhibit the greatest rapidity; it seems utterly impracticable that regular currents can be formed by such a chaos of agency; rapidity and diversity is the natural character of the action of the cilia, and it is only by the exhaustion of moisture, which can never occur in natural sites, that a subdued and more deliberate motion is attained, and even then their direction is as variable as ever; I can only consider them as the eliminating mechanism of the oxygen. The epithelium is pretty regularly deposited on the upper area of a compound membrane, one lamina being thin, horny, and of a pale yellowish brown; the other thicker, of a more mucous quality and whiter colour: this is seen by examining the edges of a section. Between those membranes which form the substance of the gill-plates the network of the blood-vessels is spread, as without such support it would fall to pieces: perhaps the roots of the cilia pass through the epithelium and its supporting membrane, and impinging or centring on the coats of the blood-vessels, by a capillary or porous action supply them with the air they extract from the water. It is scarcely possible to view a more interesting object than the structure of the branchial mechanism and operation of the cilia, by transmitted light, under a power of 300 or 400 diameters. I think these data will almost convince naturalists that these organs

cannot be the agents of a communication from the branchial chamber to the anal siphon.

It is necessary to state that occasional lesions, and now and then a perforation, are seen on the surface of the gill-laminæ, the evident effect of a casual imperfection; with these exceptions, entirety is the ruling aspect; all my fellow-observers concurred in this opinion; and two pieces of gill-lamina containing several interbranchial tubes were submitted to a distinguished metropolitan microscopist, who thus reported on them: "I can find no pores in them, unless a piece of leather may be called porous." Since this opinion a great number of the gill-membranes of the *Pholas dactylus* have been examined by transmitted light by one of Mr. Ross's microscopes, with the $\frac{1}{2}$ and $\frac{1}{4}$ of an inch object-glasses, a power more than sufficient to detect the presence of natural symmetrical apertures or pores through which *effective* permeation could be obtained; indeed that power would be equal to show pores through which no water could pass freely, and scarcely by exudation.

The gill-plates of the *Pholas parva* are more delicate than in the '*dactylus*.' No appearance of symmetrical apertures exists, but only an excessively minute wiry tracery, studded in the interstices with points, which, under a power of 300 linear, only presented a surface little larger than the point of the finest needle, and had the aspect of prominent dots rather than pores.

In the *Pholas papyracea* the gills are of the finest texture, but exhibit no appearance of a permeable structure; minute points are scattered in the tracery of the parallelograms, some of them being circled by a shallow grooved line; but this is merely a depression of the epithelium or its supporting membrane. I have preserved the preparations.

Having mentioned accidental lesions and gill-laminar imperfections, I have to add, that in testing Messrs. Alder and Hancock's chief experiment, no alcoholic injections should be used, as by their penetrating quality they may exude through these super-eminently delicate tissues; nor should mercury be

employed, as its weight in young subjects without great care often causes ruptures, and from its density it does not pass so freely as aqueous fluids. Sea-water coloured by indigo or archil, or pure, is the proper injection, which must not be pushed beyond a full distension of the interlaminar tubes. The animal should be prepared in as natural a state as possible, and not be killed by any process producing sudden asphyxia, as immersion in hot water or alcohol; the first destroys tenacity in delicate tissues; the second thickens and hardens them too much, and occasions lesions and fissures by contraction. There must be no lesions in the gill-laminæ, except those that result from imperfections, which prevail to more or less extent in every animal I have examined—at least 500; any solution of continuity at the junction of the gills with the excessively delicate membranes of the body will be fatal to success.

If the experiment is thus conducted, no injection through the anal siphon will flow into the branchial vault by the route of the interlaminar canals; the only moisture, if any, that can arrive there, may be a slight exudation, a proportionate one to the number of perforations and cracks in the membrane from laminar malformation, and of these only those which pass through into the interbranchial tubes. There may be in the 40,000 parallelograms in each gill, about twenty flaws or imperfections, and I reserve the possibility that all or most of these may arise from the manipulation of such delicate tissues.

After all these incidents, how am I to explain the great discrepancy between the experiments of the northern naturalists, illustrated by their "10,000 pores," and mine, from the impossibility of causing fluids to issue from the interbranchial tubes by percolation through the membrane on which the network of the blood-vessels is spread? But 'tis said, the sight is keener in the North than with us southrons. The only solution I can offer is a mere guess, that the animals operated on by these gentlemen, after being killed, and alcoholized to harden the fabric,—and the contractive qualities of alcohol are well known,—had, when the moisture was

evaporated, the membrane of the entire network of the branchial laminæ broken by lesions and contractions; and their fig. 3. in the plate has much the aspect of such ruptures. "I cast this idea on the waters," as Southey did "his little book," and it may have as much value as it deserves. I had scarcely written these lines when I found that my conjecture might be right. Having opened in a gill-plate an inter-branchial tube that retained the injected mercury, I cleared it of the mineral, and being dry it was placed in water to recover pliability, for fixing on a tablet, on which it was carefully spread without stretching; I found that in the central portion of the membrane of the plate almost every parallelogram was ruptured, which under the microscope showed no previous solutions of continuity, and each fissure proved a *fac-simile* of those delineated in the 'Annals,' vol. viii. N. S. pl. 15. fig. 3.

The area of the portion of the gill-plate examined contained about 2000 parallelograms in rows, and by its size caused the sphere of contractibility to centre in the middle, whilst towards the margins, a less resistance and greater elasticity prevailing, many of the rows of network preserved their integrity. I then prepared another portion of ten transverse and as many longitudinal rows; in this diminished area not a mesh was ruptured, and the membrane of the blood-vessels remained perfect. It appears then, that the moistening of the gill-plate with fresh water—and of course with alcohol a much greater effect is produced—may have caused all the fissures in Messrs. Alder and Hancock's specimens, thus fully accounting for the singularly different results of our respective injections of the anal siphon.

If I am right in these points, the question of in- and ex-currents by cilia and separate siphons is disposed of. The data of these gentlemen to show a communication between the anal and branchial vaults through the membrane of the network of the gill-laminæ not being tenable, of course their theory falls to the ground, on the principle of "sublatâ causâ, tollitur effectus;" consequently mine, as published in the 'Annals,' 1850, has not yet been proved incorrect.

Hitherto the *Pholades* have been more particularly the object of consideration; it may now be not amiss to turn our attention to a group of Bivalves which, though essentially the same, differ materially in the configuration and arrangement of many of their organs; they may perhaps assist us in searching out the truth, by the discordancy of their attributes with those of their precursors.

What view am I to take of the *Anomiæ* and *Ostreæ*, that have open mantles and no tubes; in which the water must enter at every point of the periphery that is patent, contemporaneously with the opening of the shell by the animal? Here the water cannot be passed off by what is called an anal tube, because none exists; it must therefore be discharged by the great ventral cavity. Am I to idealize, and suppose that in the same branchial vault there is a distinct current of ingress and another of egress? I may observe, that in the Gasteropoda there is a similar periodic entry and expulsion of water from the branchial chamber as in the Bivalves; and after the cilia have extracted the oxygen, I have witnessed a hundred times the forcible expulsion of the effete fluid by a jet as decided as in them;—am I here also to suppose that there are two distinct opposite currents in the same undivided cavity?

I have now to inquire how the gill-percolation, admitting for argument that it exists, is disposed of in this tribe of Bivalves without siphons. If the water permeates the gills of the *Pholades*, it must do so in the *Anomiæ* and *Ostreæ*; in the former there is a possible vent by the siphon, but none in the latter, therefore it must revert to its source, the branchial cavity. Does not this go far to prove that there is no permeation in either case?

Then, may it not be permitted us, in this asiphonal group, without having recourse to an "*olla podrida*," or hash of currents, to conclude, that when the animal opens the shell for the admission of water to bathe the branchiæ, and when that function is accomplished, it ejects the effete fluid by the same channel it entered, as no separate duct can be found? Will not the calm consideration of this case make most men doubt the existence of branchial currents either by distinct

tubes, that is one inhalant and branchial and another exhalant and anal, or by what I term suppositious ones? The former position I think I have proved in the *Pholades*, by showing that there is no effective communication between the two chambers; and in the *Anomiæ* and *Ostreæ*, that the latter condition of the currents is imaginary, appears to be the most correct view. It may therefore be considered that in the Bivalves, whatever modification their siphonal mechanism may present, all are subject to a general law of the water being expelled from the same siphon or channel at which it entered, aided by the pedal gape and pedal aperture where they exist; and in the *Anomiæ* and *Ostreæ*, in which these organs are rudimentary or entirely wanting, the water is simply received and expelled through the ventral range, and not by an imaginative inhalant and exhalant regular current, effected by cilia.

The remainder of Messrs. Alder and Hancock's paper requires no further notice except a few words on their concluding experiment showing how the colouring matters collect in the neighbourhood of the buccal aperture. I have observed these appearances, but I am of opinion, that in an animal cut up from stem to stern, with the so-called in-current, as they admit, annihilated, little dependence can be placed on the action of the gill-laminæ floated in a shallow vessel, to account for the colouring matters seen at its oral termination. And I cannot understand the hydro-pneumatic statics of these gentlemen, nor the position agreeably to their theory, that "a tendency to form a vacuum" in the anal chamber and interbranchial tubes is effected by the "flowing out" of the water from the ex-current siphon, combined with ciliary agency, which actions, they add, are the foundation of their "correct answer to this question: How is the matter, divided into such minute particles, collected on the surface of the gills?"

But a fallacy with respect to a tendency to form a vacuum seems to present itself, as in this case a flowing out involves the idea of a flowing in, which militates against the vacuum, for the fact is, that with the outflow there is in their theory a

contemporaneous succession of fluid to compensate any possible exhaustion. One would rather suppose that a tendency to a vacuum, instead of existing in the *anal chamber*, the point of issue, would be formed in the branchial vault, the source of supply, from a possible deficiency of fluid: a river shows no appearance of vacuity at its debouchure or elsewhere, whilst its sources maintain their integrity.

I can conceive in a running stream that the pressure of one portion of water on another produces an impulsion, not a vacuum; but how is this impulsion from mere declivity of gradient to operate in the Bivalves, in which the natural position of the siphons is almost invariably at an angle of 90° in reference to the horizon? How is the flow out of water to be effected in them? Are we called on to believe that the cilia, besides eliminating the oxygen for the blood, perform the function of a pumping apparatus? Surely I need not further entertain such an absurdity; we may therefore conclude that the water is expelled at intervals of two to five minutes from both chambers, by the powerful adductor muscles in combination with the siphonal retractors of the animal operating on the valves; these agents act as a *force-pump*; there is no other adequate exhausting mechanism.

I do not think the idea of ciliary currents, independent of those for the extraction of the oxygen, can be sustained. I also cannot admit, with my views of the impermeability of the gill-laminæ, that the concluding hypothesis of these gentlemen throws "some light on the sustentation of the Lamellibranchiate mollusks;" I believe the gills are strictly a respiratory machine, with the exception that they may be subservient in some or all the Bivalves to reproduction. I consider that the *palpi* are the purveyors and locomotive agents of the alimentary matters.

As a last argument I submit a syllogism, which perhaps some of your readers will say, from its decisive character, had better have been placed at the head, instead of the end of this paper, and thus they and myself would have escaped the trouble of wading through long accounts of optical and other experimental tests.

In a gill-membrane in which cilia are planted, epithelium is always present, and it and its supporting tissue cannot exist without a membranous and *mucous substratum*; these are absolutely antagonistic to water, and impermeable; therefore the gill-laminæ of the *Pholades* and other bivalves are impermeable.

I apprehend, that ciliated mucous membranes are neither absorbents nor emunctories, though the vessels of such glands may pass through them to the surface; they are probably a product by exudation from the blood-vessels, for the formation of an upper membrane and the epithelium. Thus the very constitution of the branchial plates informs the anatomist and physiologist, that there cannot through them be a communication from the branchial to the anal chamber.

It would be lost labour to prolong this disquisition, in which I fear my observations have been too often repeated, but the importance of the problem is my apology. If I have failed to convince, I have at least supplied matter for reflection, which may perhaps lead malacologists to doubt whether the doctrine of inhalant and exhalant currents by cilia and distinct apertures can be maintained against the evidence I have presented, and to admit that this long-entertained theory may prove a delusion.

I conclude with a remark of Sir William Napier, who thus offers an apology—all will exclaim, a needless one—for writing the history of what he terms "a thrice-told tale," the Peninsular War: the eloquent historian says, "that two men observing the same object will describe it diversely, according to the point of view from which either beholds it; in the eyes of one it shall be a fair prospect, to the other a barren waste, and neither may see aright."

Are the northern naturalists and myself in this category? He adds, "wherefore truth being the legitimate object of history, it is better that she should be sought for by the many than by few, lest for want of seekers, amongst false lights, she be lost altogether."

Let us then apply these views, and hope that in this branch of history many observers, besides the present controversialists,

will step in to announce the truth and dispel the mists of prejudice.

I am, Gentlemen, your most obedient servant,

WILLIAM CLARK.

TEREDO, Adanson.

I infer that this genus is still involved in great obscurity from the serious mistakes that exist in the accounts of it: this is the more remarkable, as it has attracted great attention for the last 200 years, in consequence of its devastations, which have been so alarming, that various governments have called in the aid of the learned and scientific to examine into their nature, and suggest the best means of preventing them.

Some authors, amongst them Sir Everard Home, call the external veins the ducts of the testicles, and say the heart is situated near the head. More modern accounts state that there is no true hinge; that the ligament is obsolete, and the foot rudimentary or absent; the branchiæ are described as long brown fleshy cords; the elastic stylet is mentioned as a club-shaped body peculiar to *Teredo*, and the animal is said to be furnished with two stomachs. Some observers say, that the anterior adductor muscle is well marked, but the posterior one slightly; others affirm the branchiæ to be the ovaria, and that the protective tube of *Teredo megotara* is destitute of the posterior circular laminæ. I propose to show that not one of these statements is correct. I am informed that M. Deshayes has given anatomical details of one or more of the Teredines in his work on the 'Mollusques d'Algérie,' which I have had no opportunity of consulting; I must therefore abide by my own views.

The origin of this account was the receipt from Exmouth of a pine stake, which had doubtless served as a water-mark in one of the channels of the estuary, and being destroyed by the perforations of these creatures, was taken floating in the offing at that place. I received the mass enveloped in sea-weed, accompanied by bottles of sea-water. The log contained fifty

living specimens of this rare species, unmixed with any other, many of which were apparently full-grown and 10 inches in length; some I examined alive and dissected fresh, and many others from spirits. These facilities have, I think, almost put it in my power to give a tolerably general idea of the animal, though it may not be a complete anatomical detail. Under the circumstances I have stated, I am inclined to think that the following notes may afford malacologists some information, and enable them to compare my humble attempt with the anatomies of *Teredo* by the great masters in this branch of science. Agreeably to my usual method I commence with the external description of the animal, and then proceed to its anatomy.

T. MEGOTARA, Hanley.

T. megotara, Brit. Moll. i. p. 77, pl. 1. f. 6, & pl. 18. f. 1, 2.

Animal vermicular, pale bluish-white, inclosed in a subcylindrical elongated tubular mantle, not of very thin texture, only open anteally and posteally. The specimen examined measured 8 inches from the front valves to the terminal pallets, and when the siphons were extended, an inch longer. The anterior part of the animal is inclosed in a pair of hemispherical shining white valves, with a large angular gape in front, and rounded behind into auricles, which in this species are much larger than in its congeners; the body and mantle are fixed to them, and proceed under the protection of a testaceous tube to the terminal pallets, which are also encased within the tube.

It will here be convenient to observe, that the calcareous tube through which the body passes, to be spoken of more in detail hereafter, has hitherto been considered as one of mere protection; but I shall show that though the globular valves in front work free in the tube, it is as much a part of the animal as the shell of the *Pholades*, inasmuch as it is fixed to it posteriorly by a very strong muscle.

The branchiæ are invisible until the mantle is opened. There is what appears to be a purple dull red labium on each side of the mouth, connected by a thin membrane; these have

been termed salivary glands, and may perhaps be such. The oral aperture is subtriangular. The foot in the living animal appears bluish hyaline, but when the moisture is absorbed it is muscular and coriaceous, attached to the body by a thick powerful cylindrical pedicle, and in its centre, the terminus of the hyaline stylet is visible; the form of its basal area is that of the anterior gape, which is of a diamond figure, with its angles placed vertically and transversely, but the transverse axes are longer than the vertical. A pair of yellowish-white spatulate appendages are fixed to the posterior extremity of the body. In this animal, besides the anterior and posterior apertures of the shell, there is a rather extensive oval orifice on the dorsal surface of the shell, which is covered by a thick subcircular tough skin, springing from the internal part of the anterior end of the mantle, which appears to have the valvular function of closing the orifice; but it will be mentioned again.

These are the only features of the animal which are visible without dissection. A bivalve animal consists of the shell, soft parts, and the hinge, which latter organ has caused some misconceptions, which I will endeavour to remove. In this species it is nearly similar to that of *Pholas*; the valves articulate on a thin genuine cartilage, which is a secretion from glands; on each side the anterior dorso-lateral part of the body the denticular appliances are wanting in one valve, and in the other there is only a short blunt tooth; the ligament is a united production of the glands just mentioned, and the mantle; it may be considered to be more external than internal, and only differs from *Pholas* in having one, the upper, instead of two layers of transverse fibres, strengthened and covered as in that genus by the anterior end of the mantle being reflected on it, but it is not fortified by testaceous plates. We have here all but the hinge of *Pholas*, and taking the shell as far as its circumscribed volume extends, we find it nearly similar, in having the curved subumbonal internal apophyses, the single post-medial adductor, and the long tubular mantle fixed to the auricles; but instead of the viscera and branchiæ being inclosed in the usual bivalve portion, they are placed in

that part of the mantle which is external to the shell; nevertheless they are protected by the tubular case, which, as I have stated, is an integral portion of the hard parts of the animal, not merely protective or accessorial. We have thus a complete equivalent for the bivalve shells of the *Pholades*, in which the siphonal apparatus commences at the posterior end of the shell, deriving their retractors from offsprings of the medial adductor; whereas in *Teredo* the retractors have their source from a particular muscular sphincter at the posterior end of the tubular mantle in which the pallets are inserted, and have nothing of the nature of an adductor muscle, as the tube to which they are fixed is a perfect cylinder.

The next point to engage attention is the muscular structure, which, with slight exceptions, scarcely differs from *Pholas*. The two principal masses of muscles are those of the foot and the adductor; the latter is a powerful fibrous mass of bright red filaments, as Sir Everard Home states was the colour of the species he examined; it embraces the hinder part of the mantle within the hemispherical valves, being post-medial and fixed in the internal hollows of the auricles, showing therein when removed well-marked cicatrices: this muscle throws off elastic ribands, which proceed on the lateral parts of the mantle to that point of the tubular mantle where the sphincteroidal muscle is fixed, and of which it is probably the origin: this last muscle is a most important one; by being permanently fixed to the animal and the posterior end of the protective tube, by the oval-shaped fillets springing from the sphincter muscle, it is the point of support for the retractors of the comparatively short siphons, and also the fulcrum for the pallets that are firmly fixed laterally therein, and undoubtedly serve to compress and relax the siphons. It is necessary to observe, that if the very long mantellar tube was not firmly attached, the *points d'appui* of the pallets and retractors would be lost, and the long, linear branchiæ drawn together in the tube in such a mass as to impede the passage of the water and other functions. The posterior sphincter in *Dentalium* is analogous in its uses; and though the hemispherical valves of *Teredo*

play loose in the anterior part of the tube, they are kept in proper position by the powerful operation and suction of the foot, and do not require permanent fixation like the smaller pallet end of the animal.

I will briefly explain the operation of the posterior spatulate appendages in compressing and relaxing the siphons. The very great length of the branchiæ, which are $4\frac{1}{2}$ inches long, out of a total of 8 or 9, together with the extent of the tubular cylindrical mantle, requires an aid to facilitate the flow of water through the long canal; these pallets act as a sort of force-pump, and operate thus:—When the branchiæ require water their siphon is filled, and its inflation acted on by the spatulate valves being brought together; the sphincter is simultaneously relaxed and the water forced into the branchial cavity, after which it is again closed by the separation of the pallets, and as I have ascertained that there is no communication between the branchial and anal tubes, it follows that the effete water is expelled by the same canal as it entered, by the action of the pallets on the sphincter. This is precisely the operation of the sphincter in *Dentalium*; and in case a communication did exist between the two siphons, the anal, from its very inferior calibre, could not discharge the mass of water received by the branchial siphon into the tubular branchial compartment of the mantle; it must either be poured forth by the anterior gape or branchial siphon — I believe from both indiscriminately. I think the anal canal is strictly applicable to discharge the water taken in by its own siphon, for rejectamental uses, and in many cases for the emission of ova.

The siphons, though short, form a muscular texture of strong elastic threads, crossed by others at right angles; the branchial orifice is usually white, sometimes pale red with eight or ten short terminal cirrhi, which are furnished with minute retractors springing obliquely near their extremities from the muscular tissue; the anal orifice is plain. The foot is a strong muscular mass; it sends forth two very strong fillets that are fixed to the spatulate ends of the internal crotchets, which support the body, in lieu of the ordinary

adductor muscle of bivalves, which is here, as in *Pholas*, wanting, to the remarks on which we particularly refer.

I close these observations by stating, that the masses of the foot, medial adductor, and posterior sphincter supply their respective parts of the body with the minor muscular threads.

It is time to inquire about the nervous agencies that stimulate the action of these powerful muscular organs, and we find their volume, as in *Pholas*, to be apparently not in accordance with them. There are just above the mouth two minute ganglia so nearly confluent that they may be considered as one; from them, two very slender threads descend to the roof of the anal aperture, distributing numerous ramifications to the proper stomach and foot, whilst the main cords pass into the base of that portion of the tubular mantle which contains the liver, ovarium and pericardium, in a distinct independent membrane that may be called a peritoneum, and in their passage under these organs they furnish them with filaments, and then piercing the fundus of the peritoneum enter the pericardium, and form a junction with a second larger ganglion that is fixed in that cavity in some measure enveloped by the heart and auricles, and is only visible when the pericardium is cleared of them: this mass supplies the terminal part of the ovarium, the entire branchiæ, and all the posterior parts of the body with nervous threads.

The digestive organs next present themselves. Authors have said there are two distinct stomachs; this is not so: they have mistaken the peritoneal cavity containing the liver, ovarium and pericardium, for one: the true and only stomach is within the hemispherical valves, in immediate contact with the greenish-brown liver that pours the bile into it from above; it is very small; the walls are simple; and the elastic stylet and gizzard, which some naturalists denominate the tricuspid membrane, work within it as a gizzard and attritor.

I have carefully dissected the apparatus of the present species, and have it on a card in a united state, showing the hard horny parts of the rubbing portion. Some authors say that this machine is not to be found in all bivalves. Which are without it? I am inclined to think that it is absent in none.

The mouth is a triangular V-shaped aperture placed immediately above the foot; on each side there is a palpar or salivary mass, which from its wavy streamlets appears to be of the latter quality; they have a glandular aspect, and may perhaps combine tentacular uses. The mouth opens into a short œsophagus which descends into a small stomach, the contents of which under the microscope appeared to be wood reduced to a pulpy mass, that, after having undergone the action of the gizzard, is discharged into the intestine, which, as soon as it springs from the pylorus, mounts to the integuments that divide the dorsal aperture from the peritoneal cavity, passing through them and showing from without a tubular inflation that has been mistaken for the œsophagus of the second stomach, but is undoubtedly an intestine, which I have traced and opened throughout its length. It proceeds in a straight line through the liver to about the centre of the ovarium for 1 inch $\frac{7}{10}$ths, when, by a sudden short turn, it retraces its steps for $\frac{9}{10}$ths of an inch, when it again turns and makes an oblique reach of about $\frac{1}{2}$ an inch; it then makes a further gyration, forming a complete but small sigmoid flexure, and pursues its course for 1 inch $\frac{3}{10}$ths to the anterior part of the body, which it descends, coasting for $\frac{6}{10}$ths of an inch the foot to the external pyloric point of the stomach, and, becoming a short rectum, opens into the tubular mantellar canal at some distance from the anal siphon; the whole of the circumvolution is about 5 inches, far exceeding that of the *Pholades*. The valvular dorsal flap before mentioned covers the aperture under it, assisted by a fine membrane perforated to correspond with the oval aperture, which appears to be in aid of the external valve for preventing the ingress or egress of water, except at the minute perforation in unison with the true mouth. I can conceive no other use for this valve than to admit water to the mouth, œsophagus and stomach when the foot is engaged in excavation, and in consequence perhaps the anterior gape is hermetically closed.

It would appear that the animal swallows the excavated wood, and does not eject it by currents of water. I infer this, as not only the stomach but the intestine is always filled with

a pulp, which under the microscope has the aspect of ligneous debris. The *Patellæ* operate in like manner.

The circulation is venous, arterial and branchial, and consequently complete. The respiratory apparatus has been strangely misunderstood; it has been described to consist of four fleshy cords, portions of which Sir Everard Home pronounced to be the testes, and others the ovaria; these views are erroneous. But we will first mention the heart and auricles, which are placed at the base of the ovarium in the peritoneal cavity within the mantle, but in a distinct pericardium; the heart is an elongated, very pale bluish-white opake ventricle, accompanied by two symmetrical fusiform slender auricles that are also opake, somewhat posterior to it, which appear to pour the aërated blood into it by lateral valvular ducts. On opening the ventricle its walls did not exhibit any particular muscularity: we were not successful in detecting the valves of the auricles. There is at the posterior part of the auricles a white, suboval, subglobular, fine granular mass, touching and partly surrounding them; we are unable to state its nature; it is not part of the ovarium, which terminates before the pericardium commences, and in such a situation it cannot be the organ to animalize the ova: we are inclined to consider it a gland that distils a liquor for the use of the heart and auricles.

At the base of these organs the four cords that have created such difference of opinion as to their uses come into view, but they do not appear to be either the branchiæ, arteries, veins, testes or ovaria; still they have a sort of connection with the branchiæ; the two longer and larger brown lines have their origin on each side the hemispherical valves, and proceed, attached to each latero-dorsal range of the mantle, to the posterior siphons; they appear to be composed of red-brown granular points; within these two lines, but not until the branchiæ commence, two others of smaller size and nearly similar composition run parallel, and terminate with the larger ones at the siphons; the addition of the two shorter and smaller cords springing from the larger at the point where the branchiæ begin, appears to show a connection of these

appendages with them, whatever their nature may be. We will now consider the structure of the branchiæ, and the surmises on the nature of the four brown cords that accompany them.

The branchial apparatus is composed of only two narrow laminæ running horizontally from their origin, where they are the broadest, attached to the dorsal region of the mantle and tapering gradually to the siphons; but before they approach them, for an inch or two, they become more fleshy and linear, and are what Sir Everard Home terms "the strong substance for the support of the weakest part of the body of the animal;" they do not enter the siphon, as in *Pholas*, being cut off therefrom by the posterior sphincter; their colour is reddish-brown, and the blood, as seen by the microscope, very pale pink; their length in a nine-inch animal is from 4 to 4½ inches. The branchiæ in the living animal are doubled together and hang on each other, but without the intervention of any substance between them, and in this respect are similar to the branchiæ of the *Pholades* when they have cleared the body and become linear: but in *Teredo* they are altogether posterior to the body. The branchial artery of each lamina runs, as usual, parallel, and just under their junction with the body, in the closest connection with the granular cords in question; but each branchial vein runs parallel and decidedly within the granular cords, and shows no connection with them like the arteries. What then is the nature of these appendages, particularly of the longer ones? I am inclined to consider them glandular bodies, which perhaps serve either as emunctories, to carry off injurious matters from the blood, or as absorbents of what is beneficial: I am quite at a loss to say which of these very opposite views is most probable. I will state another surmise: they may be an aid to extract additional quantities of air to invigorate the branchiæ in the production of the utmost vitality for the blood, to support the animal in the arduous labours of excavation: in this view they may be considered as rudimentary branchiæ; but after all is said, their true functions are doubtful.

With respect to the secretions, all that I know of them

has been mentioned under the heads of the organs I have described, except those of the ovary, which will be noticed hereafter. These animals, like all the Bivalves, are strict hermaphrodites. The ovarium is a white glandular body entwined with the liver, but as it approaches the pericardium it becomes a distinct mass; and, what is unusual at this time of the year (20th January), in several of the ovaria the contents had begun to assume the appearance of ova; but with the utmost power of the microscope I could not perceive any trace of the membranous pyriform bodies containing a fluid which I have observed in the genial months in many of the ovaries of the strict hermaphrodite Bivalves and Gasteropoda, which I consider to be the male influences; nor could I discover any other organ that had the slightest pretension to be regarded of a similar nature. I failed to verify the oviduct, but from the position of the ovarium I have little doubt that it passes at and under that portion of the peritoneal cavity which contains the terminus of the ovary, into the anal compartment of the mantellar tube, about 1½ inch above the siphon, and that the ova are there discharged. I do not think the branchiæ in this species serve as receptacles for the ova; their structure is not calculated for such purpose.

I will now make a few observations on the camerated structure of the posterior part of the protective tube, which has caused malacologists much speculation on its uses; some, myself amongst others, thought the laminar spaces might be to protect the pulli for a time until ultimate exclusion.

These ideas were dispelled by the discovery of the fixture of the posterior part of the animal by the strong oval muscles springing from the sphincter, which induced me to examine this portion of the tube with care, and in a fine full-grown specimen I discovered the principal object, if not the precise animal œconomy, of the laminæ. I perceived in the centre of each plate a decided muscular impression, which, on comparison with the last-formed one of the sphincter muscle, proved to be identical in shape; this fact made it evident, that the animal, either when full-grown, or when growing, if its longi-

tudinal increase is not correspondent with the boring progress, must, by being posteriorly fixed, either suspend excavation, rupture the mantle, or have the power of advancing the muscle of attachment. This advancement of the muscle is not a new fact; it has been observed in the *Spondyli* and *Ostreæ*; and it cannot be doubted that nature has conferred on the present species the power of detaching and advancing the muscle of attachment, and that each hoop-shaped lamina, thrown out for some point of the animal œconomy, marks the periodic removal of the muscle. The laminæ are always more numerous in the longer and older animals; in very young specimens there are only 1–3, and in the older ones 20–40.

When authors have stated that this species has the tube without concamerations, we presume they have only had opportunities of examining very young or imperfect specimens; in all the specimens I have seen, many of which were 10 inches long, they were present, and I belive that no species of *Teredo* is without them.

The plugging up of the terminal volutions in *Aporrhaïs* and other Gasteropoda, and the consequent withdrawal of the posterior parts of the animal, are analogous to this operation in *Teredo*; the same principle excites the action in both cases, self-preservation.

It will be observed that the alliance of *Teredo* with *Pholas*, through the apophysary processes, is more decisive than between any two other bivalve families. I trust that I shall not be considered fanciful if I venture to remark, that there are points of analogy between *Teredo* and *Dentalium* so striking as almost to give some weight to the idea that it forms the passage to the Gasteropoda; in support of these views I beg malacologists to observe the similar vermiform character of the animals, the attachment of their posterior parts to the shells by sphincteroid muscles, the peculiar plan of the admission of the water by short siphons in conjunction with the sphincter, the single branchial dorsal lamina on each side, their separation from the body, and other minor analogies. These concordances almost make me think my hypothetical surmises have some foundation, and that the transfer of *Pholas*

and *Teredo*, &c., from the bottom to the top of the scale of the Bivalves, is not an injudicious procedure.

The other British Teredines are—

T. NORVEGICA, Spengler.
T. norvegica, Brit. Moll. i. p. 66, pl. 1. f. 1–5.

T. NAVALIS, Linnæus.
T. navalis, Brit. Moll. i. p. 74, pl. 1. f. 7, 8, and pl. 18. f. 3, 4.

The following are exotic :—

T. BIPENNATA, Turton.
T. bipennata, Brit. Moll. i. p. 80, pl. 1. f. 9–11.

T. MALLEOLUS, Turton.
T. malleolus, Brit. Moll. i. p. 84, pl. 1. f. 12–14.

T. PALMULATA, Lamarck.
T. palmulata, Brit. Moll. i. p. 86, pl. 2. f. 9, 10, 11.

XYLOPHAGA, Turton.

X. DORSALIS, Turton et Auctorum.

X. dorsalis, Brit. Moll. i. p. 90, pl. 2. f. 3, 4 ; and ii. p. 375.

We met with this species alive many years since, at Exmouth, and greatly regret that it passed unobserved.

Having inserted a paper in the 'Annals of Natural History' on the Terebrating Mollusca, we will only state, that it is now generally considered that the foot and fleshy part of the ventral surface of the mantle, aided by the fine sand and siliceous particles that are a part of the animal's attributes, are the excavating agents. See Mr. A. Hancock's excellent Memoir on these points, in the 'Annals of Nat. Hist.,' N. S. ii. p. 225.

GASTEROPODA.

That this division of the Mollusca is the sequence of the Bivalves is universally acknowledged; this is shown by a body of facts that are familiar to all who cultivate this branch of science; but it is also evident that the Gasteropoda have very decided marks of an advancement to superior organization; the distinct head, eyes, tentacula, denticular apparatus, the œsophagean concentration of the medullary ganglions, the character of the foot, the almost invariable state of freedom and consequent increased facility of locomotion, together with a greater complexity of the generative developments of many of the families, are sufficient proofs of a great progress in animalization.

It is not necessary here to enter on anatomical remarks, as almost every point connected both with the internal and external animal structure is again and again mentioned in the observations concerning the different families; it would therefore be a useless repetition to extend our notes in this direction, and we at once proceed to introduce the respective families, only premising that there are still some gaps in the descriptions of the animals, but these deficiencies are daily disappearing in consequence of many recent discoveries.

DENTALIADÆ.

We are obliged to provide for this family of one genus, a distinct branchial section, which, from the symmetrical lateral disposition of the branchiæ, we have termed *Lateribranchiata*; we consider this arrangement subject to our determination of the branchiæ being confirmed. Large anatomical details of the *Dentalium Tarentinum* are annexed.

From my observations in the 'Annals of Natural History,'

1849, it appears that the minute species of the genus *Cæcum*, from their configuration, have generally been located with the *Dentalia*, though it will be seen that there is little concordance between the animals of the two genera. I believe, with the exception of M. Deshayes' monograph, that nothing has been done to elucidate this curious molluscum; and as I think that eminent malacologist has mistaken the uses of some of its organs, I am induced, by the facility of obtaining live specimens of the *Dentalium Tarentinum*, to review and augment what is at present known of it. The animal exhibits a series of characters of the highest interest, in its anatomy and functional developments, some of which are so anomalous, that it must be considered one of the most singular of the testaceous mollusca.

DENTALIUM, Linnæus.

D. Tarentinum, Lamarck.

D. Tarentinum, Brit. Moll. ii. p. 451, pl. 57. f. 12.

Animal yellowish-white, conically elongated, mantle circular, anteriorly thick and fleshy, edge dentated, posteriorly of the thinnest texture; the penultimate and antepenultimate portions of its margin are bounded by two intense white muscular elastic cordons; the united action of these has the power of completely opening and closing the anterior aperture; when at rest, the animal, including the foot, is entirely enclosed by the tougher part of the mantle which supplies the place of an operculum.

The foot is a very long and singular organ, placed in the centre of the anterior end of the body, and from its position is applicable for use in every direction; it is divided into three parts: the anterior one is a pointed cone acting in some measure as a tentaculum, and lies in the middle portion, which consists of two lateral, sinuated, symmetrical flaps or tenacula, that are usually protruded simultaneously with the terminal portion, and are the parts subservient to the animal's very confined locomotion, by using the lateral appendages as

points d'appui to turn from side to side, and also to climb and secure its food from the stems of the foraminiferous polyparia; the third or basal section is a long flattish pedicle, deeply grooved on its upper and lower surfaces, extending to the base of the stomach, into which it opens, as it is hollowed out as far as the tenacular flaps, but there is no passage to the exterior surface. I have failed to discover the reason for this connection with the stomach: the hollow part is filled with water, but from what source does not appear, though I think it must come from the buccal aperture. The use of this singular structure is clearly to augment the flexibility of the foot, as the animal frequently and suddenly doubles it up as the elephant does its trunk; and also to withdraw the two anterior parts into the hollow portion: this retractile action is necessary in consequence of the peculiar mouth of the animal and the rigid character of the anterior end of the mantle, to convey the sustentation captured by the tenacula into the cavity of the mantle within the reach of the very short foliaceous cirrhi at the buccal orifice. From the foot an elastic fibrous riband runs, on each side of the body, to the posterior terminus, and affords the animal the power of greatly contracting and dilating that end of it, as may be seen by the creases of contraction, which in some degree give the appearance of annulations.

At the base, and above the pedicle of the foot,—if that surface of the animal is upwards which lies in the *concavity* * of the shell, and *vice versâ*, in the *convexity*,—is inserted a distinct light yellow tubular buccal appendage, without eyes or tentacula, which can only be considered a kind of external œsophagus, and as regards its accessories and form, has no pretensions to be styled a head; it is encircled by about eight or ten short dendroid tentacular strands; its cavity forms two extremely dilatable pouches divided by a longitudinal septum, which become compressed and merge apparently into one at the point of passage into the stomach. These external receptacles invariably contain from ten to forty, or even more,

* *Concavity* is dorsal, *convexity* is ventral. M. Deshayes states the contrary, but he is mistaken.

very minute Foraminifera,—a convincing proof of the voracity of these animals. I have never failed to find in them either the *Quinque-*, *Tri-*, or *Bi-loculinæ*, or the *Rotalia Beccarii*, the *Lobatula vulgaris*, *Bulimina pulchella*, *Textularia oblonga*, *Lagena amphora*, or the *Robulina subcultrata*, and more rarely a minute bivalve, either the *Kellia suborbicularis* or *Astarte triangularis*: this fact is another proof, if any additional ones were necessary, that an animal inhabits the minute calcareous forms which were formerly supposed to enclose Cephalopoda, or to be inserted in their membranes; they are not inhabitants of the littoral, but of the coralline zones, and appear to be the sole aliment of this decided zoophagous mollusc. These shells are *in transitu* to be acted on by the appendage within the stomach, which will be noticed shortly, and after having undergone its action the rejectamenta are discharged anteriorly with other mucal and fæcal matters, and not at the posterior terminus agreeably to M. Deshayes' determination; and I shall presently demonstrate that the posterior aperture is not for anal uses, but to supply the branchiæ with water.

It is now necessary to mention the figure and situation of the heart and branchiæ; these points must be carefully kept in mind, as the demonstration I propose rests on a due consideration of them. The heart is a subrotund minute ventricle with a linear depression on its summit, and when opened shows the corresponding ridge; its surface is fortified with muscular raised lines; it is fixed centrally at the posterior end of the branchial cavity and base of the stomach, and in some transparent animals may be seen in the pericardium; in the very young pellucid shells seven inspirations and as many nearly isochronal expirations have been counted in a minute, and the corresponding ingress and egress of the water seen *.

* Lamarck, in the last edit. of the 'Anim. sans Vert.' (Milne-Edwards's) 3rd vol. p. 13, says, "Car, après les animaux vertébrés, la nature n'offre, dans aucun animal, ces mouvements alternatifs et mesurés d'inspiration et d'expiration du fluide inspiré," &c.

On this point that great naturalist is in error, as in *Dentalium Tarentinum* I have, with a chronometer showing seconds, repeatedly marked nearly isochronal inspirations and expirations of the aërating fluid, the two together amounting to about sixteen in a minute.

I have not detected auricles on each side of the heart, nor near it, as might be expected from the symmetry of the branchiæ; there are certainly minute points on each side of that organ, but I object to call them auricles, and rather think they denote the valvular appendages of the heart, to prevent regurgitation into the branchial veins. The blood of the posterior part of the body is brought to the branchial artery which runs at the inner base of the branchiæ, by two longitudinal veins, which pass between the branchiæ on their convex surface, receiving tributaries; I could not trace those of the anterior part. The arterial blood is then distributed into the ramifications of the branchiæ, and after aëration is passed by each principal vein, which coasts the edges of those organs at their dichotomous points, to the heart, which throws out a posterior and anterior short trunk, both of which bifurcate into two smaller arteries, which supply veins infusing a renewed vitality into all parts of the body, from whence the blood is again returned to the arterial centre. Under the microscope the blood of the tributary and superficial veins appears to be in some individuals of a pale pink colour, and in others of a purplish pale red cast.

The branchiæ are two symmetrical, sublateral, and somewhat post-centrally situated, dark greenish-brown, elongated, suboval organs, having their bases fixed on and hanging from the concave surface of the animal, with their points vertically parallel to the bases; the two branchiæ are united at their inner surfaces by a bridle of branchial strands arranged symmetrically.

The heart in the testaceous Gasteropoda, spiral and otherwise, is always placed at the posterior end of the branchial cavity, or, in other words, is fixed at that extremity of the branchiæ *furthest* from the entry of the aërating fluid *. This

* M. Milne-Edwards has placed a few genera, as *Bulla*, *Pleurobranchus*, and *Aplysia*, in his division Opisthobranchiata, as having the heart anterior to the branchiæ. Without closely considering the merits of his arrangement, which perhaps is fine-drawn and not constant, we may say, in respect of the case between M. Deshayes and myself, that it does not bear upon it, as, in whatever way the question is looked at, *Dentalium* is a strict prosobranchiate animal, with the branchiæ anterior to the heart.

statement of position is of importance in coming to a conclusion as to the mode of entry of the water. But if the position of the organs of *Dentalium* be examined under the view of the water approaching the branchiæ under the mantle, as in the ordinary Gasteropoda, they will be found to be the reverse of what I have stated to be the usual natural position; the heart will be found at the *anterior* end of the branchial cavity instead of at the posterior, and *nearest* to the entrance of the water instead of furthest from it: here is a subversion of the order of nature in respect to the position of these essential organs: how are they to be placed in harmony with her laws? The solution of this question is simple: we have only to consider that the water in this genus flows to the branchiæ by the posterior aperture instead of at the front; this view removes every difficulty, and may be regarded as a demonstration of the fact, which is satisfactory and decisive, because it is founded on the organization which nature has conferred on these animals.

I will state some facts in support of the conclusion that the branchiæ in *Dentalium* receive the water posteriorly. I admit that, notwithstanding a constriction, it may possibly enter in front under the mantle and be discharged posteriorly, and *vice versâ*; but this action would be contrary to the natural position of the organs and to the evidence I shall now adduce. But first it will be necessary to mention the mode of fixture of the animal to the shell: this is not at the centre, as in the spiral Gasteropoda, but at the posterior end, a little more than an eighth of an inch from the terminus, where, on the inner surface, may be seen the striæ, in the hollows of which the fine filaments, issuing through the mantle and proceeding from the longitudinal elastic riband running from the foot, are deposited; and, together with the strong sphincter of the posterior process, which is imbedded in an indentation not visible from without, firmly secure, by constriction, that end of the animal to the shell. This is a striking example of the admirable adaptations of nature of the organs of animals to their wants and œconomy; for if this animal was fixed to the middle of the shell as in the spiral ones, the contractibility of the poste-

rior part of the body would be destroyed, and its vermicular motion, to aid and accelerate the passage of the branchial fluid and its expulsion through the comparatively narrow medial duct, paralysed. I may state in corroboration of the foregoing observations, that I have removed the posterior hyaline process and enlarged the orifice as much as possible, and then dropped therein some grains of fine sand to irritate the membranous spoon-shaped process, when instantly pure water, without the slightest admixture of fæcal substances, was ejected; and this result was invariable in all, and many, individuals.

I have stated that in young transparent specimens an uninterrupted but slow action of systole and diastole might be observed, and was apparent from the distinct ascent and descent of the water in the branchial canal; but this action cannot take place in a merely excretory tube; it can only exist in a circulatory, or inhalant and exhalant one. I have carefully dissected the body from the branchiæ to its terminus, and submitted its substance to microscopic powers, without discovering a trace of an intestine, which is usually the easiest organ to be detected by its colour and distension. I have carefully watched thirty individuals at a time, and never saw any rejectamenta from the posterior process; but in the same period frequent discharges anteriorly from the centre of the mantle, of foraminiferous spoil enveloped in mucus. I finally observe, that on the animal being removed from the shell, the medial branchial canal is distended, but in a short time collapses from the evaporation of the fluid, and exhibits a deep canaliferous groove; and when the canal is not quite full, one or two globules, precisely like those of a spirit-level, may be made with the slightest pressure to float backwards and forwards from the posterior sphincteroid process to the branchiæ. Many other circumstances can be added in proof of the posterior entry of the branchial water, but I have already transgressed the limits of conciseness, and it is time to take some notice of the nervous system, salivary glands, the stomach and its contents, and the substances which fill up the body from the branchiæ to the posterior terminus.

At the base of the œsophagus is a cerebral mass of four minute, pale pink, subcircular, finely-punctured ganglions, in form somewhat like the letter X, united by a nervous thread or collar, which encircles the œsophagus at the point where it passes at the base of the foot into the stomach, and the fine filaments therefrom are distinctly visible passing to the stomach and throwing off anastomosing lateral threads anteriorly to the foot, buccal orifice, and the other front parts of the body.

The salivary glands are very large, covering the base of the foot and the œsophageal ganglions, and envelope the buccal pouches so completely that they seem imbedded in them; they spring from each side the base of the mouth, and are two thick fasciculi, which consist of a multitude of very fine, long, light yellow capillary strands; their extraordinary volume is necessary to produce a copious supply of fluid to lubricate the enormous quantity of Foraminifera these animals swallow, especially of the scabrous ones, as *Bulimina pulchella*, and the sharp-pointed *Lagena amphora*.

The œsophagus, after emerging from the nervous collar, instantly enters the stomachal cavity, which is composed of a muscular membrane of a broad oval form, the anterior and larger portion thereof being occupied by an extremely strong gizzard, formed of a pair of subelliptical folding jaws with eighteen laminæ bent towards the points on each side, and studded with very strong blunt teeth: this denticular frame is supported by fleshy lobes encased in corneous plates, and appears to be an organ nearly similar to the buccal mass of the ordinary Gasteropoda; it is not however placed, as in them, immediately at the anterior orifice of a pharyngeal œsophagus leading to a stomach and fixed thereto by strong elastic threads, but it is the stomach itself most slightly attached to the membrane which envelopes it. This powerful machine undoubtedly acts as a gizzard, to grind the testaceous food of this animal; it empties itself by a very short scoop-shaped canal into an intestine of three or four intricate Gordian knot-like folds, which, strange to say, often contain a dozen or more shells that have escaped the action of the

gizzard. The intestine does not entwine with the liver, but is enclosed within the same cavity as the gizzard; it pierces its enclosure on the right side, passes through the liver, and discharges the rejectamenta at the base of the branchial cavity, under the mantle about the middle of the shell, from whence they are passed, by the deep groove of the foot, which the animal can, by the compression of its sides, make canaliferous, as far as the middle section of the foot, around which, when the animals are fresh from the sea, they form repeated collars of mucus, which in a short time, from frequent aggregations of matter, become ponderous, break and fall off, and when examined are found to be composed of the spoil of shells: this circumstance, independent of all others, shows that the fæces are not discharged posteriorly.

The liver is an extremely scanty light yellowish-green organ placed under the stomach, and is continued under the branchial cavity, and then joins the ovarium, with which it becomes almost imperceptibly amalgamated throughout its whole length. The ovarium is very long and large, and fills up the whole of the posterior part of the body from the branchiæ; it consists of from four to six longitudinal rows of distinct granular yellowish-white masses of ova, with scanty interweavings of the liver, which exhibit three stages of development; the more forward ones become broken into six portions, and when ready for exclusion these again break into perfectly round, pale brown globules; all these phases vary in different animals according to the advancement of fecundation. The oviduct is in the centre of the longitudinal rows of ova, formed by their junction, and the ova are undoubtedly discharged by the posterior spoon-shaped process, from whence I have seen volleys of fifty or a hundred ejected with considerable force in minute round points: these must not be mistaken for fæcal pellets, neither must the oviduct be confounded with the branchial canal, which is the cavity formed between the mantle and the membrane of the ovarium. The homogeneity of the masses of this part of the body in many conditions, especially when fecundation is not far advanced,

renders the discrimination of organs of this character a matter of some difficulty. I have not discovered any exserted organs of reproduction, and I think from various considerations that this animal is an hermaphrodite, but without congression. Under the microscope, in the midst of the general mass, several small egg-shaped globules, having at one of the axes a minute, apparently tubular filament filled with a glairy fluid, may be seen in some individuals, but not in all, as I have sometimes searched in vain for them; these may be the virile fecundating organs, which are perhaps only apparent at certain stages of gestation.

I have extended these observations to an unusual and almost inconvenient length: the curious and anomalous structure of this mollusc, and the multitude of interesting characters attached to it, exhibit such modifications of the organs of the typical Gasteropoda as appear to give it a claim to be considered as the point of transition from the Bivalve Mollusca to the great change in figure and faculties which nature has produced in the superior developments of the Gasteropoda; and perhaps, from a review of this account of these organs, malacologists may be induced to think that it will appropriately form one of the first, if not the first link, in the chain of the Gasteropoda. The symmetrical subventral position of the branchiæ, the posterior flow of water to them, and the resemblance of the foot to that of some of the Bivalves, combined with the similar character of its action, appear in a striking manner to show its connection with the Conchifera; whilst by its œsophageal cerebral ganglions and completeness of the circulation, it has established its claims as a Gasteropod. There are also traces of alliance with some of the inferior classes: the red blood and vermiform configuration of the posterior part of the animal show some of the characters of the Annelides; but though we acknowledge these sources of its origin, we cannot fail to see how clearly the animal of *Dentalium* displays at various points the progress of advancement, and the ameliorations nature has so beneficently effected in its animality.

The present species inhabits the coralline zones of the South Devon coasts, five or six miles from land, in twelve or fifteen fathoms water.

I had written thus far when I received from Paris M. Deshayes' memoir on the *Dentalia*, which I had not seen for twenty years, and its contents had nearly passed from my memory; on looking it over I find that the differences between that gentleman and myself are more important than I was aware of, but I am not inclined to abandon my own views. I am also glad to find that I am enabled to fill up many gaps as regards the functions and habitudes of these animals.

This gentleman, in stating the anus in *Dentalium* to be posterior, observes that it is the only molluscum that has it so situated; but this anomaly, if it be so, I think I have disposed of.

Those organs which I consider to be the symmetrical branchiæ are termed by M. Deshayes the lobes of the liver, each pouring into the stomach the bile by their biliary vessels. I cannot persuade myself that this view is correct; I have submitted them to the microscope, and in each principal strand I have seen the leading vein distended with red blood, as well as the net-like connecting ramifications; I therefore consider what are called the biliary vessels to be the branchial veins conveying the blood to the heart instead of bile into the base of the stomach. M. Deshayes in his figure has omitted to mark the vein which runs at the dichotomous points of his organ, which, when viewed under high powers, is very visible, and which I take to be the branchial vein.

What I term the salivary glands, are the branchiæ with M. Deshayes, combining the functions of tentacula: he does not mention such glands. I must consider this assumption incorrect; and to support this opinion I state that the heart is separated the whole length of the stomach from the bases of what M. Deshayes terms the branchiæ: this is a position without parallel, as that organ is invariably in the closest

contact with one end of the branchiæ. That naturalist certainly connects the two organs by stating, as I think erroneously, that the heart sends great and numerous vessels to the branchiæ. Now, the heart never transmits blood directly to the branchiæ, but impels it into the system by arteries and veins, from whence, as I have already stated, it reverts to those organs.

The filaments in dispute I have submitted to microscopical observation; they only present the appearance of a complicated mass without a trace of particular arterial and branchial vessels, and they have nothing like the symmetry of branchiæ; I believe them to be merely secreting glands, and they may perhaps combine tentacular functions.

M. Deshayes is, I think, in error in stating that the aliment undergoes a second mastication: this idea has arisen from his having divided the gizzard into two parts, one of which he describes as "mâchoires," and the other as an "appareil dentaire assez compliqué:" the fact is, there are no hard parts in the buccal pouch; which, when removed, there being no internal œsophagus, exposes to view the anterior part of the gizzard, which is likened to two spherical black points gaping like a small bivalve: these are only part and parcel of a *whole*—the gizzard,—which may almost be called the stomach itself, as it fills the entire stomachal membrane, with the exception of the convoluted intestine at its base; consequently the aliment has no other mastication but of one denticular apparatus.

That there are no errors in these observations would be an undue assumption; for who, on such subjects and in the examination of these minute objects, can hope to escape from occasional error? I invite malacologists to offer their corrections, if I have differed on insufficient grounds from so eminent a naturalist as M. Deshayes; and I conclude with the evocation,

> ..... Si quid novisti rectius istis,
> Candidus imperti.

D. ENTALIS, Linn. et Auct.

D. entalis, Brit. Moll. ii. p. 449, pl. 57. f. 11.

I have only seen one live specimen of the *D. entalis*; the organs have the same characters as those of the *Tarentinum*, but it is very distinct; the colour is snow-white, and on comparison of two shells of the same size, the *D. entalis* will be found much more slender; the branchiæ are of a paler green, more scanty, thin and delicate.

Having had good opportunities of reviewing my notes, I have thought that it would be desirable to mention the result; and I am the more anxious to do so, as I have the misfortune to differ on all essentials with zoologists whose talents have long stamped their judgment on these subjects as authorities scarcely to be disputed. I am unable to make any material correction in the preceding observations; I can only add some fresh incidents and offer a few explanations. In carrying out these views I must again allude to M. Deshayes' and his coadjutor M. d'Orbigny's monograph; it appears to me that there are in it some misconceptions, in addition to those I have already pointed out, which if passed over may mislead.

M. Deshayes says that the convexity of the shell answers to the dorsal range, and the concavity to the ventral; the reverse is the case, as I have proved in a hundred specimens, unless it be contended that the foot is placed above the head or buccal pouch on the dorsal range, instead of being under it on the ventral line, agreeably to the order of nature. Again, the heart is stated to be fixed on the dorsal surface above the stomach, and in the figure delineated it is lying on that organ and exceeding it in length; but repeated examinations inform me that what is called and figured as the heart is the masticatory apparatus and intestine, which lie in the stomachal cavity, and demonstrate their presence by a marked inflation. The heart, as I have mentioned, is a minute organ at the base, but separated from the stomach by a septum or rib, and immersed in the centre of the dorsal and ventral surfaces;

it cannot be well seen from the dorsal area, but in transparent individuals may often be observed in the pericardium from the ventral surface, without dissection, between the bases of the stomach and branchiæ.

The following remarks give a more correct view of the character of the liver. *The real liver* — not my branchiæ, which M. Deshayes states to be the liver — consists of two symmetrical subcentral masses, one on each side, formed of 10–15 subrotund, pale to dark brown granular lobes, and of each group the biliary duct can be observed to pierce the peritoneum. With regard to the salivary glands — M. Deshayes' branchiæ — I have again examined them, and traced their pedicles and ducts to spring on each side of the œsophagus at its junction with the stomach, and, as I think, supply the buccal pouch with a lubricating secretion to assist deglutition. I can discover no connection between the heart and these organs. All examples show that the foraminiferous fæcal spoil is discharged anteriorly, and I think that there can be no question of the entry of the branchial water by the posterior canal, which, with M. Deshayes, is the anal conduit. As a positive proof of this arrangement, I repeat, in confirmation of my former statement, that in many young delicate pellucid individuals, I have both by sun and artificial light seen the water, in whatever *position* the shell is held, ascend and descend in the tube for the aëration of the blood, by alternate contraction and dilatation; in fresh animals the inspirations and expirations are, *each*, 5–8 in a minute, or together 10–16; but when they have been kept some days and suffered from want of food, the times of the two actions are more irregular and fewer; and still more so when the water has become effete, by the animal being long detained under examination: these processes can be observed for many days until nature is exhausted. I submit that these are strong reasons in support of the posterior admission of the branchial water, and that what has been called the anal issue is undoubtedly the aquiferous canal. I again beg to impress on zoologists, that no organ of simple depuration or excretion is ever under systole and diastole influences.

CHITONIDÆ.

Before I enter on this family, I beg to state, that a more extended experience of the Mollusca has compelled me to relieve myself, in part, of the assistance of conchological attributes, as I have found them singularly defective and fallacious in reference to the existing constitutions of divisions, families and genera. I therefore, as regards the past, and henceforth, shall only consider the shell-coverings of the Mollusca as good and useful aids, in strict subservience to the malacology of the animal, and as consequential specialties emanating from the vital organs; and that the meaning of whatever appellation may be attached to a division, family or genus, has with me no reference to the testaceology: for instance, speaking of the *Muricidæ*, or its synonym, the *Canalifera*, the shell is not in question, except as a corroborating incident, but the animalia canalifera, whose mantles form canals; and in like manner, in mentioning the *Holostomata*, the entire periphery of the aperture is not primarily intended, but, that the mantle lining it is entire.

The use of the word 'shell,' instead of 'animal,' in the construction of the subordinate divisions of a class, has doubtless arisen from the ignorance of naturalists of the inhabitants; but as this cause is in a great measure removed, it is time to abandon a system founded on fallacious bases, and have recourse to nature's imperishable land-marks.

In these observations, I do not mean to say that conchology is without its use: to palæontologists, collections of shells are the only resources to denote that their fossils present similarities to many existing forms; but how infinitely more valuable is an account of an existing animal, to inform them of the real character of the relics of former epochs! Beyond the restricted points, conchology is totally unworthy to be the succedaneum of the attributes of nature, and the true worshipers of the great book will rejoice at the decadence of a usurpation to its just limits.

The Chitons have long been a source of difference of opinion with naturalists, not only as to their position amongst the Mollusca, but it has been insisted on, that they are apocryphal members of that class. The greatest authorities are in collision: M. De Blainville considers that the motive power and other apparatus of the circulation have a rectilinear dorsal arrangement, similar to that of the Annelida: Cuvier and Lamarck regard them as true Mollusca, ranging with the Patelloid group: Professor Forbes has doubts, and looks on the question as still within the limits of debateable ground, and terms the Chitons malacological "puzzles." Some observers contend, that the reproductive organs, unlike the asymmetrical ones of the Gasteropoda, exhibit a disposition of parities on a medial line, and like M. De Blainville refer them to the Annelida. Milne-Edwards demurs that they are Mollusca, and goes no further than to regard them as an aberrant tribe of Gasteropoda.

Having dissected many examples of three species, I think that my notes may assist zoologists in coming to sound conclusions with respect to natural position. As my investigations have induced a chain of reasoning which has convinced me that the Chitons are true Mollusca of the Patelloid type, it may be as well at once to allude to that part of them which bears upon the objections that have just been stated.

Though doubts have lately sprung up as to the natural position of these curious animals, they have, until now, been placed by most authors in close connection with the Conchifera. If this is right, what then is there extraordinary and unusual in the disposition of the organs of the circulation? They have nearly the same dorsal rectilinear position as in the Acephala, from which they have long been considered, and I think it will be shown rightly, the point of transition to the Gasteropoda. Why not, therefore, contrast this peculiar arrangement, which is the invariable consequence of the symmetry of the bivalve animal, with that which obtains in the Chitons from the same cause, and also in others of the Patelloid tribe that have the same position and a similar parity of their organs? I admit, that the strict *Patellæ*, though

symmetrical in their testaceous cones, are exceptions with regard to the heart, auricle, and branchial plume: *Haliotis*, which with me is a patelloid animal, and also an exception, is the reverse, having the organs of the respiratory circulation symmetrical, but not the cone. These, and two or three other genera, may be regarded as the precursors of the Gasteropoda, and as points of transition from the strict parities of the cone of the shell and organs of the Patelloida, to the asymmetrical division of the Gasteropoda.

The only differences, and they are not important, with respect to the position of the circulation in the Bivalves and Chitons are, that in the latter the motive power is placed greatly more posteriorly than in the former; and the illustrious Cuvier has taught us to observe, that the auricles of the Chitons have a quadruple connection with the heart, of which he has seen no other example in the animal kingdom: this is not stated in an objective sense, but as a curious fact, though he gives no reason for this aberration of the usual structure. Enough has now been said to demonstrate the little value of the much-insisted-on dorsal rectilinear position of the motive power of the circulation in *Chiton*, in comparison with the Annelida.

As to the objection to the allocation of these animals with the Mollusca on account of the symmetry of the reproductive organs, we think they are of small importance, even if double: and who can say that the symmetrical Patelloida have not in this respect a similar structure? but these points are doubtful. M. Deshayes says, "Quoique nous ayons fait des anatomies minutieuses d'Oscabrions, il nous a été impossible de trouver la seconde issue des organes de la génération;" and M. Cuvier observes, they became so attenuated that he confessed he could not trace them. Our own researches lead to doubts of these appendages being oviducts; at the same time we admit, they may prove to exercise those functions: they are situate in the immediate vicinity of the heart and auricles, and may be glands to secrete a liquor for those organs, or the fecundating pouches of the peculiar hermaphroditism of this tribe; in which latter case, the true issue for the ova will probably be

found between the rectum and the posterior part of the ovarian sac.

It has been said that the body is subannulate: in a hundred dissections we could not see much trace of such configuration, or breaks in it to correspond with the segmental arrangement of the valves; only slight marks, the effect of pressure, were observed. The connection of the Chitons with the Crustacea is, I think, so very slight and remote as to require no further notice.

Having cursorily disposed of certain objections, we will proceed to state our own views, and in their course, allude to other objections and discrepancies. Though the Chitons are in closer alliance with the Bivalves, anatomically, by the arrangement of the circulatory apparatus, symmetry of the branchiæ, and by the absence of tentacula and eyes, than by the external hard parts; still in them, there are points of coherence which are not without their value: for instance, in *Pholas dactylus*, which it almost immediately follows in our method, though the bivalve portion is not broken into regular segments, there are certain testaceous pieces, commonly, though perhaps incorrectly, called accessories, in number six, including the principal valves. We also find in the Chitons a subsymmetrical division into eight segments of what I consider essentially an integral patelloid cone, and as much accessorial as those of *Pholas*; indeed both in one and the other, these component parts are equally necessary and essential. I admit that no great stress ought to be laid on the contrasted points; nevertheless, in conjunction with other decided anatomical analogies, they have their weight in the balance.

Our view of the natural position of *Chiton* is after *Dentalium*, with which it has marked affinities, and in immediate contact with the Patelloid group, in which we regard, in almost every respect, *Fissurella* as the point of comparison, as in it is seen the same form of the cone, though entire instead of broken, the same parity of the branchiæ, a similar posterior anal debouchure, and the attenuated mantle, gradually thickening, in both genera, to a tumid coriaceous margin, which in *Fis-*

surella can scarcely be withdrawn within the shell, studded alike in both with papillæ and rugosities, and the same marginal fringes. The nervous masses in the two accord closely: the only exception is the striking, but really unimportant, division of the cone of the Chitons into segments; but this incident may be accounted for on very simple grounds. We consider the fracture of the shell not a character denoting an affinity with the Annelida, as the body of the animal has no corresponding articulations, but simply an aid to facilitate locomotion. The foot of the strict symmetrical testaceous Gasteropoda is generally nearly concurrent with the length of the body, and forms its base, from which, by a gradually increasing cone, the animal becomes at maturity fixed to the summit of the shell by a powerful muscle: this structure united to an entire cone, and combined, as in the Bivalves, with the depressing effects of a complete hermaphroditism, that of *Venus sine concubitu*, almost extinguishes the locomotive functions; and we see throughout the Patelloid tribe, all of which have a foot co-extensive with the body, an almost entire fixation to the same spot; indeed we believe that some of the *Patellæ* pass their existence in the depressions of the rock on which they are cast as embryos, and the same apathy exists in *Pileopsis* and *Calyptræa*. But nature has judged fit to give the Chitons additional motive powers, for when fixed on the area of a smooth pebble, they will travel off it, whilst the *Patellæ* are immoveable: this is owing to the integrity of the cone, and the enormous muscle which fixes the animal to its apex. This structure does not permit the body sufficient flexibility for much progression, and almost confines it to a vertical elevation and depression; but the Chitons, by the segmental condition of their shells, have accorded to them sufficient flexibility to obtain a vermicular motion, and its consequence, a greater facility of march. The Trachelipoda have infinitely superior attributes for motion, from the foot being fixed to a small portion of the body by an elastic cylindrical pedicle that affords a perfect pliability, and the acquisition of the necessary undulatory quality to effect a comparatively facile progression.

The above remarks perhaps furnish us with the proper value of the arguments of malacologists in favour of the Chitons being, by the peculiar disposition of the testaceous covering, allied to the Articulata.

It is scarcely necessary to observe, that the usual single powerful muscle of attachment of the animal to the shell in the Patelloid tribe, is in *Chiton*, from a necessity arising from the disunited structure of the cone, converted into a minuter series of coordinate muscles to attach it and each section of the shell in its proper position.

It will now be convenient to look at the anatomy of these animals, of which the most important feature are the medullary masses, and for an account of them we refer to the descriptive notes on *Chiton fascicularis*, in which will be seen the unmistakeable œsophageal collar of the Mollusca, without a trace of the longitudinal knotted or ganglionic cordon of the Annelida, or any of that division of the Articulata termed Crustacea, including the Cirripoda. This point alone is, perhaps, decisive of the question at issue. The next consideration are the organs of the circulation; these, by being disposed on a mesial line, dorsally, and more externally than in the strict Gasteropoda, have a greater alliance with the conchiferous type; and as they exhibit some unusual variations in their composition, it will be necessary to examine with detail the extraordinary, I believe unique, structure of these organs, and I hope to arrive at such probable conclusions as will account for the rationale of this abnormal disposition.

The posterior position of the motive power of the circulation will, I think, assist in solving this problem, and must always be kept in view.

If we divide the longitudinal area of the animal into eight equal sections, the heart will be found near the hinder extremity, and may be considered as composed of two inflations connected by an intermediate marked strangulation; but between them, there is an isochronal systole and diastole action; the anterior inflation is of an elongated oval shape, and the largest; the posterior is considerably smaller and

more subrotund. The auricles receiving blood from the branchial veins communicate in the usual lateral manner with the greater division of the heart, and at this point present their largest calibre; they then form an attenuated arcuation on each side the constricted portion, and effect a second contact at the sides of the lesser inflation, which may be regarded as an aortic ventricle receiving the blood by a special auricular apparatus. From the anterior axis of the major part of the heart, a long and large aorta or arterial vein ascends medially to the front, distributing by diverging arteries the aërated fluid to the greater portion of the body, whilst the minor and posterior ventricle, after receiving from the arcuated ducts of the auricles its quota of blood, serves the remaining area; but I could not detect a descending arterial vein, which however must exist to convey the blood; unless one of the arteries of the ascending aorta doubles back and supplies the part. But this conjecture is scarcely tenable, as we must then suppose, that the blood conveyed by the arcuation of the auricles to the lower inflation is thrown back again on them and the larger ventricle, thus producing a useless periodic action and counteraction.

We will endeavour to explain the probable causes and effects of this unusual construction. It has been shown that the principal ventricle of the heart is the propelling power of the blood to the major part of the body, and the smaller one by its separate auricular contact supplies the remainder; we have also observed on the connection of both parts of the heart by the strangulated and without doubt valvular intervening portion, so that no blood can pass between the two; and it is clear that none is intended to pass, as the auricles by distinct ducts supply each with its proportion of the vital fluid; consequently the mitral valves of the ventricles are closed at their axes abutting on the strangulation at each simultaneous dilatation, and thus this constriction acts as a *point d'appui* and of departure, and enables them to exercise a full power of propulsion.

We shall now perceive the reason for these separate inflations. If one only had existed, with an ascending and de-

scending aortic vein of similar calibre, as much blood would be sent to a very small area as to one seven times more extensive, and so great an inconvenience would have resulted, that nature has created this peculiar mode to effect a just distribution. I hope I have almost proved that this anomalous structure is a consequence of the posterior position of the heart.

I have extended these remarks somewhat beyond what is necessary, but I am anxious to show that this curious contrivance to effect a particular object has nothing in it essentially contrary to the molluscan type; in other respects, as in it, the circulation is aortic, venous, and particular, the blood being brought from the body by the venæ cavæ to the great arterial vein of the respiratory organ, from whence it is distributed to its minor arteries, and after aëration reverts by the branchial vein to the auricles and heart, to repeat, as long as life lasts, the same course; consequently it is completely molluscan, and appears more advanced in composition than that of the Annelida, by the presence of a much more effective motive power of the heart and auricles, which in the Articulata are comparatively obsolete, or mere continuous fluctuating cylinders or inflations. A short œsophagus conducts to the stomach, which is an irregular subcylindrical cavity, about double the diameter of the pyloric extremity; it traverses the body, forming a sudden curvature like the doubling of a horse-shoe, and returns across the body with the posterior portion parallel to the anterior one, commencing at the pyloric orifice a very long intestine of five or six transverse or oblique folds, supported by the liver, and disemboguing as the rectum, at the centre of the posterior extremity between the branchiæ. This is quite different in the Articulata, in which the intestine runs without inflexions through the middle of the body.

For further particulars we refer to the description of the type, as well as for the liver, ovary, and foot, all of which present no essential variation from the molluscan type, except the double oviduct, if such be the case.

The Chitons are best illustrated by the Patelloid section

of the class, from which they are inseparable, but there is scarcely a group of Mollusca to which they are not allied. The posterior termination of the rectum is not without example; it is essentially the same in *Fissurella*, and more or less so in many of the *Bullidæ* and *Pleurobranchidæ*. M. Deshayes observes, that the want of eyes and tentacula has been adduced as denoting affinity with the Annelida; but, as we have already observed, why not compare these deficiencies with the Conchifera, their immediate predecessors? And as regards the Gasteropoda, the absence of eyes and tentacula is not unusual: for instance, *Bulla cylindracea* has not a trace of these organs; the *Velutina otis* of authors, Mr. Gray's *Otina*, has no tentacula; some of the *Bullidæ* are without eyes, and others without tentacula; there are examples of the *Naticæ* without eyes, and in the *Dentalia* both eyes and tentacula are absent. *Dentalium*, in my method, is placed in the van of the Gasteropoda, and *Chiton* follows; both are closely allied, and, we think, appropriately succeed the Conchifera.

I do not say that, with the latter, the characters of alliance are very decided; still, on examination there will be found analogies: for instance, in *Chiton* and *Dentalium* the branchiæ are placed symmetrically, though varying in particular position. In *Chiton*, though not in *Dentalium*, the anus has the same posterior site as in the Conchifera and in some of the patelloid forms. The strict sexual order of hermaphroditism appears to obtain in both, and throughout the Patelloida to the *Pleurobranchidæ* and *Bullidæ*, in which a more influential plan of reproduction commences. These notes, in conjunction with the special typical ones, only call for a very brief summary, and we think a calm review of all the circumstances that are adduced will go far to convince zoologists that there is not a *locus standi* for any organ in *Chiton* contrary to molluscan essential characters;—all are confirmatory of the *Chitonidæ* belonging to that class, and the only return we can make *per contra* is—*nil*.

It has been suggested by Professor Forbes in the 'British Mollusca,' vol. ii. p. 390, that an examination of the fœtal metamorphoses of the Chitons would throw light on their

natural position; I propose, if practicable, to carry out this idea, though the attempt will be attended with difficulties and uncertainties, which need not now be alluded to.

We are not sure that much will be gained by the investigation; it may possibly give us an idea of the affinities of remoter lineages with the present conditions of a particular genus or species; but we think the arrival of the animal, after its embryonic phases, at an adult state, will not only give a knowledge of what it is not, but of what it actually is, and more will be gained by a comparative view of the mature organs with those of its allies.

We apply these remarks to the present case, and think that the œsophageal nervous collar, the buccal mass, the long spinous tongue, the system of the circulation, and the true Gasteropodan foot, will inform us that such an animal cannot be either one of the Annelida or Cirripoda, or belong to any other group of the Articulata; and we believe that the comparative examination of the above-mentioned organs with those of the Conchifera and Patelloida will irresistibly lead us to acknowledge their true molluscan composition.

The British Chitons are a group of about ten species: we give notes of three, selecting the *C. fascicularis* as the type. They inhabit all the zones according to their respective special habits. As regards British geographical distribution, they appear to arrive at larger growth in the northern latitudes.

CHITON, Linnæus.

C. FASCICULARIS, Linn. et Auct.

C. fascicularis, Brit. Moll. ii. p. 393, pl. 59. f. 5.

Animal forming an elongated oval, the body being convex on the upper surface, and enveloped in a mantle, thin above, but gradually resolving into a thick, strong, broad, granular margin, clothed with a rigid setose white fringe, and also furnished on each side with eight bundles of yellowish-white bristles, 12–15 in each, and two of the same number at the anterior

end; above these are imbedded, in the margin and longitudinal area of the animal, eight transverse, convex, saddle-shaped, beaked, imbricated, strongly shagreened, dark grey testaceous plates, whereof the anterior one has five emarginations, the six behind in succession one on each side, and two on the terminal margin of the eighth. The head is a membranous puckered frill, under which is the rugosely-rayed buccal disk with its round orifice in the centre: there are neither eyes nor tentacula. The buccal apparatus consists of two elliptical white, or pale yellow corneous plates, between which a rather long, black, strap-shaped tongue passes, armed with a double line of tubercles, the inner edges being tricuspid; at the base of the corneous plates is a nervous collar of five minute subrotund yellow ganglions; these are followed by the œsophagus, which leads into a complicated stomach doubled on itself, and is continued as an intestine of four or five folds, supported by the liver, which from their complexity can scarcely be described, as they lie in a space of little more than $\frac{1}{8}$th of an inch; the last fold passes into a moderately long rectum that discharges in the centre of the branchial cordon; the convolutions can be easily drawn out, and with the stomach, œsophageal canal and rectum, produce an extent of nearly 2 inches in moderate-sized examples. The pale yellow, minutely granular, sinuated ovarium is immediately under the mantle, nearly co-extensive with the length of the body, and under it are the stomach and other organs, including the large liver of many granular dusky greenish-brown lobes. The foot is suboval, very little angular in front, slightly tapering to an obtuse termination. The under part of the mantle is of a red-brown colour. Between the foot and mantle is the branchial cordon, composed of fifteen oblique, cord-like, short, close-set, pale brown fillets, on each side the body, commencing at the right and left of the immediate posterior extremity, leaving between the series only room for the depuratory duct; the cordon does not quite extend half the length of the body; the fillets gradually diminish in volume from the posterior end, and at the anteal termination are not more than half the length or size of the hindmost ones. There are no traces of male repro-

ductive organs; and of the other sex, we only meet with the doubtful oviducts, and a conspicuous well-filled ovarium in the genial epoch; it may therefore be inferred that these animals depend on their own individual generative influences.

C. ASELLUS, Chemnitz.

C. asellus, Brit. Moll. ii. p. 407, pl. 59. f. 1, 2; (animal) pl. A. A. f. 5.
C. cinereus, Auct.

The anatomy of this species is nearly the same as of the preceding, which we have considered the type of the genus, and as the external organs do not vary greatly, I shall only mention the deviations; the principal, and I believe the only one of the least consequence, is, that there are only ten branchial fillets on each side the body, which do not nearly occupy half the extent of its circumference. The inner surface of the mantle in different individuals exhibits the various hues of flesh-colour: the foot is a dull muddy purple. The margin of the mantle is powdered with minute, granular, dark, sand-like points, and fringed with very short, fine, close-set, pale yellow filaments.

This species, at Exmouth, is rarely met with in the littoral or laminarian districts; its habitat is within the coralline limits, and it is scarce.

C. CINEREUS, Linnæus.

C. cinereus, Brit. Moll. ii. p. 402, pl. 58. f. 1, as *C. marginatus*.
C. marginatus, Auct.

The same remarks apply to this as to the preceding species, from which the only decided variation is the greater number of branchial leaflets, being seventeen on each side, of a dull flesh-colour, and occupying considerably more than half the circumference of the mantle, which on its inner surface is also flesh-colour. A fine, setose, short, thick, pale rufous fringe clothes the margin of the mantle, which is minutely granulated, as if aspersed with dark sand-points.

This very common species is strictly, at Exmouth, a littoral one, and rarely found beyond its limits.

The other British Chitons are—

C. DISCREPANS, Brown.
C. discrepans, Brit. Moll. ii. p. 396, pl. 58. f. 4.

C. HANLEYI, Bean.
C. Hanleyi, Brit. Moll. ii. p. 398, pl. 62. f. 1 & f. 1 *a*, 5th valve.

C. RUBER, Linnæus.
C. ruber, Brit. Moll. ii. p. 399, pl. 59. f. 6; (animal) pl. A. A. f. 6.

C. LÆVIS, Pennant.
C. lævis, Brit. Moll. ii. p. 411, pl. 58. f. 3.

C. CANCELLATUS, Sowerby.
C. cancellatus, Brit. Moll. ii. p. 410, pl. 59. f. 3.

C. ALBUS, Linnæus.
C. albus, Brit. Moll. ii. p. 405, pl. 62. f. 2 & f. 2 *a*, 5th valve.

C. MARMOREUS, Fabricius.
C. marmoreus, Brit. Moll. ii. p. 414, pl. 58. f. 2, and pl. 59. f. 4.

We have seen none of the above alive. The *C. discrepans* is not strictly British; it inhabits the French coasts and Channel Islands. We are almost of opinion that it is distinct from the *C. fascicularis*.

PATELLIDÆ.

In my observations on the Chitons, I have stated that they would be incomplete unless naturalists were afforded the means of comparing them with the Patelloid genera, to which they exhibit the closest alliance—so much so, that no particular violence would be done to natural position if they were regarded as a genus of the *Patellidæ*. I now supply the materials for comparison, which I think will confirm my views of the position of the Chitons as true mollusca, and be in some other points interesting to the readers of this branch of zoology.

The Patelloida, as I designate them, are the *Fissurellidæ*, *Calyptræadæ*, and *Haliotidæ* of authors, which families I shall dispense with, retaining the derivative genera as components of the *Patellidæ*; these, with the addition of *Patella*, *Acmæa*,

Emarginula, Puncturella and *Pileopsis,* will form the group which I term *Cervicobranchiata,* the branchial plumose apparatus being single or double.

In natural order, we consider that the first genera of this family are *Fissurella, Emarginula, Puncturella* and *Haliotis*; which are well distinguished from the succeeding Patelloid forms, by the double branchiæ that descend symmetrically on each side the neck; and by the heart with its two auricles embracing the rectum, which debouches wherever the fissure or perforation in the shell is situate; these points, with the symmetry of the testaceous cone in all, except *Haliotis,* almost lead us to suppose that we have not yet done with the Conchifera, and induce us, from the like parity of the branchial organs, to place these genera next to the Chitons.

* *With double symmetrical branchial leaves, and the heart and two auricles clasping the intestine.*

FISSURELLA, Bruguière.

F. RETICULATA, Donovan.

F. reticulata, Brit. Moll. ii. p. 469, pl. 63. f. 4, 5; (animal) pl. B.B. f. 7.
Patella Græca, Auctorum.

Shell symmetrical, oblong, bluntly subconical, perforated at the apex, and roughly reticulated.

Animal at the base suboval, forming an obtuse pyramid, having the mantle cloven at the summit to meet the perforation behind the vertex, which is anterior, but becomes merged in the fissure of adult shells. The mantle is fleshy, and thickened as it approaches the margins of the cone, and there acquires a coriaceous texture, being produced into a tumid *rouleau,* with a dentated or furbelowed frill, garnished with stout papillæ; in adult animals the mantle can scarcely be withdrawn within; the outer surface is studded with minute yellowish-white eminences, having between them light brown lines or blotches; the inner side is flake-white, mixed with short lead-coloured lines. The head is a short muzzle issuing from a small puckered extension of the mantle, marked at its

base with a few minute brown points; the orifice is radiated sparingly with pale brown lines; the tentacula are white, strong and short, slightly tapering, with the eyes at the external bases scarcely raised. The buccal mass consists of the usual fleshy palate and corneous plates, through which a spinous lingual riband passes into the œsophagus and stomach. The foot is an elongated oval, which in full extension exceeds the length of the shell; its colour on the under part varies from yellowish-white to an intenser yellow; on the upper, it is aspersed with brown sand-like dots, mixed with yellow nearer the margin. The branchial apparatus consists of two pale brown, rather long, transversely striated plumes, each folded on itself; these originate in a cavity of the neck, and proceed on each side of it to form near the front a pointed termination; it is probable they receive water both from the basal cavity and vertical fissure. The intestine as soon as it emerges from the stomach, having run some way as duodenum, is doubled over the centre of the liver, which is mixed up with the ovarium, and passes as a simple rectum girded by the heart and auricles to its debouchure, the vertical fissure, between the pedicles of the branchiæ.

These animals are not uncommon on the littoral rocks, and are also taken on the marine masses of the coralline zone.

EMARGINULA, Lamarck.

E. RETICULATA, Sowerby et Auctorum.

E. reticulata, Brit. Moll. ii. p. 477, pl. 63. f. 1 (as *Mülleri*).
E. rosea, Bell.
———, Brit. Moll. ii. p. 479, pl. 63. f. 3.

Animal inhabiting a white, strong, reticulated, subsymmetrical, conical, emarginate shell; the vertex is slightly coiled posteriorly, and lies laterally in very young specimens, but when adult it becomes blunt and obliterated; this circumstance, with the rosy tint in fresh examples, have converted a unique British species into two. The mantle is white, slightly dentated at the margin; the head is a short, smooth, pale yellow muzzle, with the disk of the mouth rayed with flake-

white lines, within which are the usual fleshy corneous plates and spinous tongue; the tentacula are long, pointed, white, setose, with large eyes on short offsets placed very laterally at the exterior bases. The foot is pedicled, oval, pale yellow above and below, having around it, near its junction with the body, which at that part is flake-white, a cordon of about twenty-four short, thick, white fillets.

In this species, the two branchial leaves are fixed by small united pedicles in a cavity at the back of the neck, with the leafy portion falling on each side the fissure; the stomach, with the intestine, is enveloped by the liver, and the rectum, after issuing from the black green mass, which is, at the upper part of the animal, mixed up with the lighter-coloured ovarium, is, as in the last species, embraced by the heart and two auricles, and terminates at the fissure. The œsophagus is short, and encircled by three or four yellow medullary ganglions, throwing off the usual nervous threads. We here supply an omission in the last species, by stating that in it nearly the same nervous arrangement is seen.

The salivary glands are two fasciculi of filaments, greatly resembling those of *Dentalium tarentinum*. We infer from this circumstance that, like that animal, this also is a zoophagite, and feeds on scabrous food that requires a copious saliva to assist deglutition.

All the animals of the Patelloid group are without opercula; it is said that the *Pileopsis* secretes from the foot a rudimentary testaceous lamina, but, though we have observed many of the *P. hungarica*, this peculiarity was not observed, and we think, when that species is spoken of below, we may explain what has given rise to this idea.

The *E. reticulata*, and the variety, are taken in abundance at certain epochs in the coralline zone at Exmouth. The only other species is the

E. CRASSA, J. Sowerby.

E. crassa, Brit. Moll. ii. p. 481, pl. 63. f. 2; (animal) pl. C.C. f. 2.

PUNCTURELLA, Lowe.

P. NOACHINA, Linnæus.

P. noachina, Brit. Moll. ii. p. 474, pl. 62. f. 10, 11, 12; (animal) pl. B. B. f. 4, 5, 6.

This *Puncturella* is a northern and Scotch species, and I believe has not occurred on the southern coasts; I therefore refer for all that is known of it to the 'British Mollusca,' vol. ii. p. 474, which contains an excellent description of the shell and animal.

HALIOTIS, Linnæus.

H. TUBERCULATA, Linn. et Auct.

H. tuberculata, Brit. Moll. ii. p. 485, pl. 64; (animal) pl. C. C. f. 3.

This species is the only one of the genus, and cannot be strictly considered indigenous; it appears to be admitted in the list as an inhabitant of Guernsey, our ancient contiguous dependency. That the eminent French zoologists and commentators on Lamarck should have stated that *Haliotis* has the closest alliance with the *Trochi*, is so extraordinary, and, as I think, so contrary to fact, that I could scarcely believe I had read right. Naturalists, after they have examined this comparative statement, will judge where the error lies. I set out with the invocation, "Cuvierum legitote!" That illustrious anatomist says, "On pourrait presque dire que la *Fissurelle* est un *Haliotide*;" and of course *vice versâ*, I think it will be shown that *Haliotis* and *Trochus* are considerably removed from each other.

This genus presents the first evidence of departure of that symmetry in the shell, which has hitherto characterized this portion of the Gasteropoda; and in the remaining genera of the group, either in the shell or animal, marks of the non-symmetrical structure will appear, which will henceforth become more and more developed, until the termination of the class.

Though *Haliotis* has abandoned the strict patelloid form, it still, by the animal, declares the closest relationship with *Fissurella*.

I will now shortly examine this condition, and at the same time include the comparison with the *Trochi*.

Haliotis, in common with *Fissurella*, has a double symmetrical branchial plume, two auricles, and a ventricle embracing the rectum, which terminates between the roots of the branchiæ. The *Trochi* have not an analogous point: in them, there is only *one* auricle and one branchial leaf, a heart not in contact with the intestine, and the rectum far removed from it, at the front of the right side. Again, the perforations are for the similar purpose of the fissure in the *Fissurellæ*, for the dejections, and to admit the water to the respiratory vault. Nothing of this obtains in *Trochus*; and further, the fringes and ornaments about the head, and the cordon of filaments in *Haliotis* are in unison with *Fissurella* and *Emarginula*. The *Trochi*, we admit, exhibit indices on these points, and they are those which show the nearest approach to *Haliotis*. In addition to these deviations, most malacologists would say, that *Fissurella* and *Haliotis* are strict hermaphrodites, and the *Trochi* bisexual. I was of this opinion, but I believe that there are grave reasons to doubt this arrangement, and which lead me to consider the *Trochi* subject to one of the modifications of hermaphroditism. These views, and some other very curious circumstances relative to them, will be communicated in our observations on the *Trochidæ*. And lastly, *Fissurella* and *Haliotis* are without opercula, the *Trochi* never; the former are almost always fixtures, but the latter are locomotive.

I have now gone through the principal anatomical and external aspects and habitudes of the contrasted objects, and, finding scarcely a point of community between them, I am bound to admit that *Haliotis* and the *Fissurellæ* cannot be separated, and that the *Trochi* must rest where we have placed them in our method,—in the neighbourhood of their brethren that have circular opercula.

If the genus *Scissurella*, now *incertæ sedis*, does not belong to the *Trochidæ*, we should not be surprised to find that its position is near *Haliotis*.

The *Haliotis tuberculata* is not strictly British; it inhabits Guernsey and the other Channel islands.

*** With a single branchial leaf, and the heart and one auricle, not in contact with the intestine.*

This section of the *Patellidæ* comprises the typical *Patellæ, Acmæa, Calyptræa,* and *Pileopsis,* which have a single branchial plume, and all but symmetrical shells.

PATELLA, Linnæus.

P. PELLUCIDA, Linn.

P. pellucida, Brit. Moll. ii. p. 429, pl. 61. f. 3, 4; (animal) pl. A.A. f. 1.
P. lævis, Auctorum.

Shell, an obtuse symmetrical cone of variable altitudes, with striæ or fine ribs, and intense cerulean lines radiating from the vertex, which is anteal, to the basal periphery.

Animal when young ovately convex; when adult, subconical and often much depressed. As long as the shell maintains the character of the "*pellucida*" of authors, it has a regular figure, but as soon as adolescence has passed, then the animal almost always begins to increase its circumference in a different plane, the pellucidity diminishes, and the full-grown shell becomes opake, when it will be seen that the original form, styled *pellucida,* forms the subcentral vertex of the adult *P. lævis.* This condition may be observed in most full-grown examples, and thus declares the identity of the two forms so emphatically, as to render it unnecessary to examine the animals for distinctive characters. It is difficult to conceive on what grounds they have been separated. I have, however, compared a large series, in all stages of growth, of the pellucidan animal with the *P. lævis*; it is almost needless to say, the organs are similar in every respect, allowing for the variations of colour dependent on age.

The mantle does not extend beyond the shell, except that a cordon of about 50–65 equidistant, rather long, extremely slender, sharp-pointed, white, tentacular filaments, proceeding from minute eminences contiguous to the fine lead-coloured line that borders its circumference, floats beyond the margin. These are so fine as to require a good lens to see them: on

the upper surface there are three other lead-coloured bands, varying in breadth; the one immediately above the foot is narrow and faint; the next is the broadest, and takes the shape of the circular muscle, distinctly shadowing out its strong, thick-set, transverse muscular filaments; the uppermost is narrow, and the most intense in colour. The mantle within is white, and between its margin and the body is placed the branchial cordon of 80–100 white subtriangular plates, margined at the outer edges, and so extremely close-set as to present the appearance of mere thread-like filaments without depth; these line $\frac{4}{5}$ths of the circumference, passing round the posterior end, where they are largest, diminishing gradually anteally, until they are interrupted by the head.

I am of opinion with Professor Forbes, that this cordon is only an elongated branchial plume springing from the neck, and ought not to be looked on as a pair of symmetrical subsemicircular laminæ, as in the cyclobranchiate Chitons. I think this view is confirmed by the animal having the ventricle accompanied by only *one* auricle instead of two, as in *Chiton*. The heart and auricle does not span the intestine, as in nearly all the Bivalves, and in the last section. This is a remarkable departure from the usual structure, and indicates an approach to the more advanced Gasteropoda, and points out that *Patella* ought to follow *Fissurella* and *Emarginula*. The head is a plain subcircular muzzle, under which is the oval, puckered, hollowed-out mouth with a vertical fissure; and, within, the corneous plates may be seen, supporting the lead-coloured palate, and the very long, narrow, light yellow spinous tongue passing through the œsophagus, that is spirally coiled in the stomach, which pursues its course as an intestine, with many circumvolutions entwined with the liver, which in this species is a light green granular mass; near the posterior end it doubles, and, accompanied by the oviduct, terminates a little to the right of the neck under the tentaculum, and not, as is more usual, lower in the side of the body, and more posterior; the anal tube and the oviduct march together to the right side, the former being double the size of the latter. The ten-

tacula are white, shortish, rounded, tumid at the bases, tapering, but not to a fine point, setose, and in young animals there is a transparent line from base to point; the eyes are small, at the external bases, though raised a little on them. The foot, when at rest, is nearly a regular oval, but in action becomes greatly elongated, and often puckered anteriorly; the sole is yellowish-white, edged by a fine brown line, and on the upper surface has a clouding of bistre hues. No exserted *organe générateur* is seen in this group, therefore the animal belongs to that category which is styled "self-sufficient." This term requires some explanation.

All the *Conchifera, Patellæ* and *Chitons,* notwithstanding this deficiency, have well-filled ovaria in the genial season; but that is not sufficient without a communion of both the sexual influences, which, though they may exist in the same body, must be essentially distinct. It will be asked, where, and what, are the male organs of this tribe? If the animals are examined when the "genitabilis aura Favoni" impresses all nature with its magic influence, they will be found to be full of ova, mixed with a milky fluid, which under the microscope will appear to proceed from minute membranous bodies interspersed or attached to the ovarium; these organs may furnish the vital powers; but we have searched in vain for them when the ova are in a more advanced state. I have also observed these phænomena in *Dentalium Tarentinum.*

It is only agreeably to the foregoing conditions that I admit the doctrine of self-sufficiency. I do not believe that a mysterious, invisible, and unknown principle, contrary to nature as handed down to us, and independent of sexual union, exists in this, or any other class; the gemmæ of the *Polypi* and scissions of the Monads are not exceptions. I believe that a universal law has impressed a distinct sexual union on all animated nature. It is in this sense only that animals suffice for themselves; that is, they must as fully exercise their peculiar, though united, male and female influences, as if they were bisexual; I therefore consider the hermaphroditism of this group of that character which I have already designated, *Venus sine concubitû.*

The remarks on this species are inconveniently extended, in consequence of conchologists insisting on two of its forms being distinct.

These animals are found, when young, on the broad leaves of the *Laminariæ*, and when adult, imbedded in the centre of their roots.

P. VULGATA, Linnæus.

P. vulgata, Auctorum.
———, Brit. Moll. ii. p. 421, pl. 61. f. 5, 6.

Animal at the base subcircular, inhabiting a shell of various subconical altitudes; vertex anterior, from which fine striæ or rough ribs radiate, accompanied by distinct concentric lines of increase. Mantle pale lead or smoke colour, even with the margin of the cone, except that it is edged with pale brown, very fine, sharp-pointed filaments of three lengths, which vibrate beyond the shell. The branchiæ, with respect to the mantle, body and head, are placed as in the last species; they consist of a cordon of pale lead-coloured, strong, close-set, subcircular plates, having the outward edges slightly margined. Head large, lead-colour; aperture of the mouth with a transverse or vertical fissure, often puckered, dependent on the will of the animal; tentacula of the different hues of smoke-colour, long, strong, conical, sharp-pointed, tumid at the base; eyes minute, very little raised at the external bases. Foot oval, light lead-colour above and below, with numerous still paler anastomosing lines; margin thin, with a pale border; it is fastened to the body by a very powerful long pedicle, the adhesive muscular powers of which defy the efforts of the strongest man to move, without aid, even in moderate-sized examples. The buccal mass of corneous plates, coiled tongue, and other organs, are so nearly identical with those of the preceding species, that we refer to it to prevent a repetition.

How many of these creatures exist is a mystery; which remark does not apply to either *P. lævis* or *P. athletica*, as they always have access to the Algæ, and are submerged many hours out of the twenty-four. But the *P. vulgata* are often fixed for months, perhaps years, on rocks, at altitudes where they can rarely, if at all, be aspersed by the sea, and are

debarred access to marine vegetables; their recorded descents from high levels, and periodical exits from, and returns to, the identical hollows they have made, after feeding on algæ, have almost a fabulous complexion; zones of sand fifty yards wide often intervene between them and such food, and their exceedingly slow locomotion is opposed to such manœuvres.

As these animals are often for long periods prevented from obtaining animalculæ from the water, it would appear that they have the power of drawing nourishment from the saline particles floating in the air, and extracted from their porous habitations. This idea is in some measure confirmed by the fact, that in all the animals I have observed of this species the intestine has always been filled with sand. I am now speaking of isolated individuals, which, however, are frequent and of all sizes. The great mass of the *P. vulgata* in the lower levels have the means of obtaining submersion and vegetable food.

P. ATHLETICA, Bean.

P. athletica, Brit. Moll. ii. p. 425, pl. 61. f. 7, 8.

The anatomy and external organs of this species scarcely differ from those of the *P. pellucida*, and as they have a still greater similarity to the *P. vulgata*, with which it has long been confounded, I will describe the principal variations, which, however, constitute sufficient specific distinction. The animal differs from *P. vulgata* in its much lighter colour, and in the substitution of the shades of orange-yellow for the lead- or pale smoke-brown. The mantle is edged with flake-white pointed filaments, twice as short and thick as in its congener. The branchial plates are longer, thinner, paler, and more arcuated at the terminations. The foot is of the various hues of orange-yellow, with scarcely any anastomosing lines. The head is of the palest purple; the tentacula pale yellow, shorter and more slender than in *P. vulgata*. I do not, except in particular cases, regard colour of much distinctive aid, but here the organic deviations corroborate this dubious character.

This species has long been known on the Devon coast as the China Limpet, from the rich porcellanous interior aspect,

when compared with the commoner appearance of its congener. The two species inhabit generally different levels, the *P. vulgata* occupying the higher one. This species is partially distributed; it is found tolerably plentiful in an area of half a dozen acres near Exmouth, very few of the *P. vulgata* being in company in its own level; but these are congregated in great numbers in the higher levels, with the *P. athletica* rarely amongst them. The great distinguishing character of the two is the fringe of the mantle, which in the *athletica* is snow-white, but in its congener a pale uniform drab; it also varies in length and thickness; a comparison of them in sea-water will at once impress a conviction that they are specifically distinct.

ACMÆA, Eschscholtz.

A. VIRGINEA, Müller.

A. virginea, Brit. Moll. ii. p. 437, pl. 61. f. 1, 2.
Patella virginea, Auctorum.

Animal oblong-oval, pale yellow, inhabiting a subconical patelloid shell marked with shallow radiating lines, and minute, pink, narrow longitudinal fasciæ; vertex anterior; mantle even with the shell, bordered with a rather long fimbriated fringe, inflected gently inwards; it is interspersed with red patches and pink lines to correspond with those on the test. Head dull pale orange, sometimes rose-colour, issuing from the end to which the apex curves; it appears very short by being separated from the neck by a conspicuous circular white veil, or rather pavilion, with a pendent oval flap or lappet on each side; the neck is pale rose; the buccal disk has a vertical fissure, within which are two pointed, linear, greenish corneous plates supporting the palate, through which a long, red-brown, narrow lingual riband passes to the œsophagus and stomach. The tentacula are long, white, setose, eminently contractile, tumid at the bases, conically tapering to a fine point, with eyes on very short pedicles, at their external bases. The foot in extension is an elongated oval, plain-edged, white on both surfaces, quite plain, and destitute of papillæ or ornament around the strong fleshy pedicle. The arcuated

branchial plume issues from the back of the neck; in a state of quiescence it does not appear long, but can be greatly extended and contracted, like a pair of ladies' cross-barred forceps; it is composed of a pectinated leaf of almost horizontal, compact, rather short, blunt strands: the artery and branchial vein are easily observed; the plume gradually curves and tapers from its origin to a pointed termination, and is of the palest uniform hyaline drab; it may be often seen exserted and vibrating like a tentaculum in all directions; the anus is close under the plume, and emits large pale yellow cylindrical pellets. I should have mentioned that the foot, when the young are expelled from the matrix, serves as a nidus for the membranous vesicular envelope, which when the embryos have left it is discharged, as in *Ianthina*.

It inhabits the coralline zone at Exmouth in abundance, adhering to old bivalves and other substances.

This genus shows a considerable departure from *Patella* in the character and figure of the branchial leaf, and conducts us to *Calyptræa* and *Pileopsis*.

We have not seen the animals of the three following species —with us, *Acmææ—A. testudinalis*, *A. fulva*, and *A. ancyloides*, as they are not generally inhabitants of the southern coasts of Britain. Scotland has the greater claim to them. From what we have learnt of two of the animals, we prefer depositing them in *Acmæa*, rather than adopting the new genera, "*Pilidium*" for the "*fulva*," and "*Propilidium*" for the "*ancyloide*"; and we will only further observe, that if the latter has *two* branchial plumes, it ought, agreeably to our system, to be referred to the first Patellidan group; but the references will enable malacologists to judge for themselves.

A. TESTUDINALIS, Müller.

A. testudinalis, Brit. Moll. ii. p. 434, pl. 62. f. 8, 9; (animal) pl. A.A. f. 2.

A. FULVA, Müller et nobis.

Pilidium fulvum, Brit. Moll. ii. p. 441, pl. 62. f. 6, 7; (animal) pl. A. A. f. 3.

A. ANCYLOIDES, Forbes et nobis.

Propilidium ancyloide, Brit. Moll. ii. p. 443, pl. 62. f. 3, 4, 5; (animal) pl. A. A. f. 4.

CALYPTRÆA AND PILEOPSIS.

A few general remarks on *Calyptræa* and *Pileopsis*, the two remaining genera of this tribe, may not be unsuitable before their specialties are noticed: each has only a single British species; their shells, with the addition of minute spiral apices, have the symmetrical patelloid figure, and a like crescent-shaped muscular cicatrix. The animal appears, essentially, similar to the *Patellæ*: there is only a single branchial plume; their inaptitude for locomotion is accordant, nay, even more rigid; the deep marginal sinuosities of their testaceous cones show that they adapt their growth to the inequalities of the substances on which probably the germs are cast; the only movement seems confined to the elevation and depression of the shell, to receive the ambient element; they possess the same apparent hermaphroditism as their allies, and prove that this system of sexuality is the concomitant of apathy and a less developed organization. *Calyptræa*, from its symmetry, organs and habitudes, appears almost congeneric with *Pileopsis*, and a well-established member of the Limpet family; still, some malacologists have doubts as to its natural position, which arise from the singular internal rudimentary subspiral lamina. I almost think it is properly placed, and that the appendage just mentioned is one of the evidences of a transition-form on the confines of a family about to pass into an advanced structure and organization.

PILEOPSIS, Lamarck.

P. HUNGARICUS, Linn. et Auct.

P. hungaricus, Brit. Moll. ii. p. 459, pl. 60. f. 1, 2 (as *Capulus*); (animal) pl. C. C. f. 5.

Animal inhabiting a rough, irregular, subconical shell, with a minute spirally-twisted posterior vertex, from which striæ of various sizes radiate to the basal periphery; it is clothed with a thin caducous epidermis, and in the interior some examples exhibit a brilliant porcellanous white, and others the variable

hues of the rose. The *Emarginulæ* present similar conditions. This remark is of some value to confirm natural position. The mantle thickens gradually from the vertex to the base, and is coloured in different individuals white, or tinted with pale pink, and is also bordered with a dull red fringe. The head is an elongated, grooved, emarginate muzzle; the tentacula are yellow, long, tumid at the base, conically tapering as in *Patella*, with eyes on distinct but not much raised eminences at the external bases. The branchial apparatus consists of a heart and one auricle, and a series of long pale brown filaments, which spring from the base of the walls of the cervical cavity, and do not present a compact plumose leaf. The foot is tough, coriaceous and circular, with an anterior puckered ruff, or upper skin, or sort of mentum. This leads me to observe again on the fact mentioned on my authority in the 'British Mollusca,' that the matrix, or part thereof, is sometimes, perhaps always, detached, and deposited on the neck of the foot, for further development of the ova, for some time previous to being committed to take care of themselves. The same phænomenon is observable in *Ianthina*, which will be fully spoken of hereafter; and I will now add, that with respect to the so-called rudimentary lamina, which is stated, though I have never seen it, to be sometimes observed on the foot of this species, that it probably has its origin in a compressed mass of testaceous pulli in adherence with it.

Our examples, being taken many years ago from oysters brought into Exmouth by the French dredgers for the oyster plantations at Lympstone, though fresh, were sluggish, and did not enable us to complete the descriptive notes with all the accuracy that was desirable.

Calyptræa and this species are exceedingly rare on the southern coasts, off Exmouth, but, thirty years ago, the *P. hungaricus* were found in abundance in Torbay; this is not so now: their disappearance is probably owing to the oysters being all dredged, or buried beyond extrication by the shifting of the marine beds of shingle. Our supplies from the Jerseymen's trawl vessels have long been cut off, in consequence of the French and English governments, to

prevent disputes about their respective oyster limits, having debarred their entry into the Exe. I am very desirous to review these species; naturalists visiting the French coasts ought to be on the look-out, as the oyster dredgers, if properly instructed, can furnish both these animals as well as the Chitons.

CALYPTRÆA, Lamarck.

C. SINENSIS, Linnæus et Auct.

C. sinensis, Brit. Moll. ii. p. 463, pl. 60. f. 3, 4, 5; (animal) pl. B. B. f. 8–13.

I can say nothing of this species beyond the general remarks already made: I have never seen the animal in a sufficiently lively condition to exsert the organs. In the hope of examining these animals under more favourable circumstances, I refer in the interim to the 'British Mollusca,' vol. ii. p. 463, for some account of the *C. sinensis*.

PLEUROBRANCHIDÆ.

The above family, with the *Aplysiadæ* and *Bullidæ*, constitute a group of the congressional hermaphrodital division. We designate the first family *Pleurobranchiata*, from the branchiæ being fixed between the disks on one side only; and the *Aplysiadæ* and *Bullidæ*, *Cryptibranchiata*, from their branchial mechanism being deposited in variously-situated dorsal crypts, which differ in character and position from those of the cervical regions. The heart in this group is placed laterally, or somewhat anterior to the branchiæ, instead of posterior, as in the major part of the Gasteropoda. M. Cuvier's admirable memoirs and figures illustrate both positions.

The *Pleurobranchidæ* are the Semiphyllidiens of Lamarck, and contain two genera, only one being British, with two species; it cannot, on account of material anatomical considerations, be associated with the *Chitones* and *Patellæ*; only one

side of the body is furnished with a branchial plume, from which circumstance the family derives its name. The heart is non-symmetrical, with one auricle, and lies on the right side anterior, and in contact with the branchial plume; and its hermaphroditism being modified by congression, none of the Patelloid genera can receive it. The *Bullidæ* and *Aplysiadæ* reject the genus, from the very different disposition of the branchiæ; neither can it be deposited in *Lamellaria*, in which we have placed the *L. perspicua* of Montagu, which, though somewhat similar in outward appearance, is an animal closely allied to the *Muricidæ*. It appears then that this aberrant group must be intercalated in the main line where the least violence is done to natural order; it is therefore fixed immediately after the Patelloid forms, as first showing that advanced system of reproduction termed hermaphroditism with mutual congression.

PLEUROBRANCHUS, Cuvier.

P. MEMBRANACEUS, Montagu.

P. membranaceus, Brit. Moll. iii. p.558, pl. 114. f. 5; (animal) pl. X. X. f. 3.
Lamellaria membranacea, Montagu.

Animal thick, placed between two large subcircular disks; the ventral one, which is the foot, is symmetrical, and in the specimen observed, when fully extended was 4 inches in diameter; its colour underneath pale yellow, marked with a multitude of irregular anastomosing deeper yellow lines. The dorsal disk is strong and coriaceous, and an inch less in diameter than the ventral one; it is nearly symmetrical, having a sinuosity posteally and anteally, with, at about its centre, imbedded in the skin, a very thin, wrinkled, membranous, blush-coloured auriform shield, exhibiting a metallic lustre; its posterior extremity is subspiral, and its use is for the protection of the viscera, but not of the branchial plume, which is without its range; the upper disk is studded with numerous large and smaller yellow prominent papillæ, and in

their interstices a red-brown colour meanders in various breadths and irregular blotches, interspersed with cloudings of pale yellow flakes. The body within, and the internal area of the disks, are pale bluish-white, the ventral margins being aspersed to an inch in depth with yellowish-white spots, but the dorsal ones are plain. The head is a thick muzzle springing from the centre of a slightly auricled membrane, pale blue on the under surface, and on the upper sprinkled with flake-white and red points; under this membrane is the mouth, within which is a spinous lingual riband that reaches to the first stomach; from its upper part spring two cloven, though apparently tubular, short tentacula, united at their origins but diverging to their points, marked with close-set lines and snow-white dots; the eyes are immersed in the centre of the bases of the tentacula, which give them an obsolete appearance.

This animal is an hermaphrodite with congression; the male organs are white, placed between the disks, close to the right side of the head, and composed of two processes; the first is a moderately-sized, rounded, arcuated, conically pointed stylet, connected with a tubular cylindrical body reflexed at the margin; the second is a perfectly white thread-like filament issuing therefrom: these appear to be the virile appendages; they are in continual motion, and perhaps act in concert, the one being the verge, the other an epididymis or spermatic cord: above them is the vulva combined with the oviduct; it is a long, conical, very white, tumid process, ½ an inch long, with a considerable orifice. Next to these on the same side, between the disks, extending nearly their entire length, is the splendid branchial plume, which in the animal observed measured nearly 2 inches in length, composed of two gently arcuated leaves, tapering from their bases to a pointed extremity; each leaf consists of about twenty-five linear vessels or processes, resembling a twisted cord with a longitudinal depression in its centre, which is the branchial artery, and crossed on each side by transverse lines; these cord-like fillets are closely packed together and taper to

their terminations, which float free for about ¼ of an inch. The two portions of the plume fold on each other, with fine short cilia on each of the striæ, to beat the water and eliminate air therefrom; the *tout ensemble* presents a very beautiful branchial plumose appendage, of a pale brown colour, aspersed throughout with minute light flake-brown spots. The margins of the ventral disk are often, as in the *Bullidæ*, reflexed on the dorsal one, and the animal continually twists them into various sinuous shapes; when in full extension they float on the surface of the water; it is very probable that the large flexible margins of the disk not only minister to a creeping locomotion, but also serve for natation.

In this animal we see an illustration of the doctrine I have advanced, that a more elaborate composition of the generative organs usually produces greater energy in the motive powers. As to the internal anatomy I may observe, that I have dissected five large individuals, and from the base of the œsophagus there are four stomachal cavities; the two first descend in a straight line, and form with the other two a right-angled turn to the right side, and terminate in an intestine and rectum at the posterior right termination under the branchiæ; the stomachs are pear-shaped, some plain, and others ridged at the internal surfaces. The heart lies in a pericardium, accompanied by its auricle, near the anterior end of the animal, and the right side; it is only a simple ventricle receiving the oxygenated blood from the auricle. The liver is large, of a green colour, and posterior to it is the light yellow granular suboval ovary: the salivary filaments have some resemblance to those of *Dentalium Tarentinum*, but are fixed much further from the mouth than in that animal. There is nothing particular in the nervous cordon of two ganglia, from which the threads, in large animals, may be observed by the naked eye radiating to all parts.

These animals are frequently met with in the coralline zone in summer, and in the winter are often washed on the Warren Sands, at Exmouth, in considerable numbers.

P. PLUMULA, Montagu.

P. plumula, Brit. Moll. iii. p. 559, pl. 114. F. f. 6, 7; (animal) pl. X. X. f. 1.

Animal throughout pale orange-yellow, except that on both surfaces its pellucidity causes the elongated oval, incipient spiral, very patulous shield of the viscera to give the centres of both areas a dark lead appearance, in consequence of the purplish-red colour of the shell. The mantle is oval, sinuated at the margins, displaying throughout the upper surface an irregular network formed by fine whitish lines on the yellow ground-colour; the meshes gradually progress from the centre of the apex to the marginal periphery; the under surface is plain. The area of the mantellar disk considerably surpasses the pedal one. The foot is a smaller corresponding oval, also sinuated, rounded in front, and deeply emarginate behind at the anal point. The head at its junction with the body has a strong, flat, thick neck, which gradually extends into a compressed thinish apron, transverse, rounded in the centre, and forming at its right and left angles very short, blunt, incipient tentacular flaps, as in some of the *Bullæ*; the mouth is a transverse fissure beneath; the tentacula are large, approximate, thick; apparently tubular, but are really membranes folded to simulate tubes, truncate at the extremities, with a muddy red-brown line in the centre from base to point; they spring from the neck at some little distance from its junction with the body, and bifurcate at an angle of about 45°. The eyes are large, black, immersed in the skin behind the bifurcation; they are rarely seen, being carried on the march, which is much slower than in its congener, under the upper mantle. The animal, of which the above is an account, was sent to Bath, in sea-water, in December 1850, and proved lively.

To observe on the anatomy would be to repeat that of *P. membranaceus*; its generalities are absolutely the same, with some scarcely appreciable specialties. Though the progression of the animal is slow, it is in every respect superior to the Patelloid tribe, except *Chiton*, with which this genus has undoubted alliance. It is rare at Exmouth, but the acquisition

of two lively examples has enabled me to supply some account of the beautiful respiratory plume, which, however, scarcely differs from that of *P. membranaceus*; it proceeds from the anterior part of the right side, and lies in the groove of the disks. It consists of a gently arcuated stem, having on each side 20–25 oblique rami sloping posteriorly, which are finely ciliated, to beat the water to extract the air; the two sets of strands fall together from each side of the stem, forming when expanded an elegant plumose *rouleau*, tapering gently from its origin to a conical though obtuse posterior termination, and for a third of its length floating free.

APLYSIADÆ.

This most ancient and celebrated family, from the fabulous incidents that have for so many ages been attributed to it, has received a greater share of attention from the learned of all countries than any other mollusc. This harmless creature, like the inoffensive Toad, has immemorially been loathed and buffeted, not only by every ignorant rustic, but by the thoughtless of superior grade; more evils than ever issued from Pandora's box have been laid to its charge; it has had the character of being the ready agent of every sorceress and practised Canidia, to rid the world of fathers who have lived too long, and avenge the deadly offences of the lusts and passions. The distinguished zoologists of every nation and age have described its external and internal configuration; I need only mention the elaborate anatomies of Baron Cuvier, M. De Blainville, and M. De Férussac; it would therefore be supererogatory and almost presumptuous to meddle with that which has received the investigations of such distinguished naturalists; we use a wise discretion in only referring to their labours, and particularly to the memoir of M. Cuvier; this eminent man must always be regarded as a model of singular fidelity combined with admirable descriptive simplicity.

There is only one well-authenticated British species, the

very common Linnæan *A. depilans*, which may be seen in certain seasons, at Exmouth, in thousands, feeding on the Algæ of the littoral districts.

APLYSIA, Linnæus.

A. DEPILANS, Pennant et Auct.

A. hybrida, Brit. Moll. iii. p. 554, pl. 114. F. f. 4; (animal) pl. Y. Y. f. 1.

BULLIDÆ.

The *Bullidæ* which inhabit the South Devon coast at Exmouth are deposited in two groups, which undoubtedly as to essentials are of the same tribe, and have long been adopted: the one, *Bulla*, of which the *B. hydatis* and *B. lignaria* are the types, receives the species with external hard parts; the other, *Bullæa*, is represented by *B. aperta*, and is the receptacle of those with concealed shells. From these roots some new genera have sprung, to meet the supposed requirements of modern discoveries, most of which are very minute; some are without eyes, all are without distinct tentacula, or with the mere rudiments of them, and have the pedal lobe more or less reflected laterally on itself, and partially on the anterior end of the shell; in others the lax margins of the deep sinus, at the under part of the foot, which separate it from the linear posterior portion, occasion it to appear nearly as simple as in the usual run of the Gasteropoda; this latter circumstance has led to some mistakes, as will appear in the descriptions of the minute species.

All the species I have met with have the invariable distinguishing character of the tribe, the gizzard consisting of three testaceous, coriaceous or cartilaginous plates. I believe that every true *Bulla* and *Bullæa* have one or the other of these appendages; indeed it may be considered, that if an animal, however much it appears by the shell to belong to this family, has not the shibboleth of the gizzard, it is an alien to it.

The new genera of this tribe have been established by

M. Lovèn, amongst them *Cylichna* and *Amphisphyra*, but the minuter species are so rarely met with alive, that they can scarcely be placed with certainty; and to add to the difficulty, the excellent Lovèn, one of the most careful observers, has I think fallen into some error with respect to the genus *Cylichna*, the generic diagnoses of which would appear, from our present notes on two of the species he has deposited therein, the *B. cylindracea* and *B. truncata*, not to be founded on correct bases. But what naturalist does not sometimes fail in his views, from various causes, especially in the investigation of the difficult tribes of the minuter animals?

I propose to show that the *B. cylindracea* and *B. truncata* are congeneric with *B. hydatis*; if this be so, I may further observe, that on analogical considerations it is extremely probable that M. Lovèn's *B. umbilicata*, which is also one of our indigena, is in the same category as to error, and, with our *B. obtusa* and *B. mammillata*, not yet I believe observed, will turn out to be strict *Bullæ*. Until these minute creatures have been submitted to fresh examinations, this family cannot be settled; no conchological considerations will suffice. It may be that the unobserved species will afford valid generic distinction; but I think, from the constancy of structure of all the *Bullæ* that have been adequately observed, they will, though the presumption rests on analogical grounds, be found to have the tripartite gizzard and typical foot with its accessory lobe extending from one extremity of the animal to the other, with the sides more or less reflexed, producing the quadrilobated character of the tribe.

I can say little of the genus *Amphisphyra*; the only British species, the *B. hyalina*, is not found on our southern coasts, and the notices of it are so meagre, that at present it can only be placed provisionally. It has been stated to have neither gizzard nor head-disc; if so, it cannot belong to the *Bullidæ*; it is possible those parts in so minute a being may have escaped detection, and it may prove to be a *Bulla*. Naturalists residing near the locality of this species should re-examine these points and communicate their notes.

The *Scaphander* of Montfort is synonymous with *Bulla*,

and the *Philine* of Ascanius, adopted by M. Lovèn, with *Bullæa*: though these ancient titles may have priority of date, still, whatever injustice may be done—and it would appear, from the want of support of these genera, that it cannot be great—it is impossible at this time of day to dispense with the *Bulla* of Linnæus and Lamarck, and the *Bullæa* of the latter, which have been so long in use and universally acknowledged.

I have given a general and anatomical description of *Bulla hydatis* from many live individuals, which have enabled me to verify the observations of M. Cuvier, to fill up some gaps, and I believe to correct some errors, which, for the reasons I have assigned below, have escaped the attention of that prince of anatomists.

* *Shell external.*

BULLA, Linnæus.

B. HYDATIS, Linn. et Auct.

B. hydatis, Brit. Moll. iii. p. 530, pl. 114. D. f. 7; (animal) pl. U.U. f. 3.

Animal, when fully extended, of an elongated oval shape. The upper or tentacular lobe, and that of the foot, with its reflected portions, are of a pale yellow, aspersed with very minute, close-set, sand-like, dark mouse or lead-coloured points throughout their external surface; the spots on that part of the mantle covered by the shell are larger and of intenser hue, so that the animal has altogether the aspect of being clothed in a close-sprinkled pepper-and-salt jacket. The sinus around the body, which divides the upper and lower lobes, is of a pale yellowish-white colour. The tentacular lobe of the head is small, of subquadrangular form, a little narrowed behind, where, as well as in front, it is gently sinuated, with slight emarginations at the centre of both ends, which by no means give their right and left extremities any pretension to be styled four tentacula, agreeably to M. Cuvier's view. The true mantle extends to the posterior part of the tentacular lobe, with its thickened rounded margin swelling out a little beyond the periphery of the aperture of

the shell; that part of it covering the branchiæ, heart, bladder, matrix and testis is of firm texture; the portion within the posterior part of the spire, containing the liver, ovarium and oviduct, is a mere film, but stronger than would be supposed from its tenuity; at the posterior end of the shell the dorsal range is completed by the reflexion on it of the hindermost part of the pedal lobe. The anterior part of the under lobe forming the foot is precisely of the same length and width as the upper one, but more posteriorly it spreads like a fin, which is reflected on the sides of the shell; the disk then pursues its course for two-thirds of its length posteriorly, at which point its continuity is broken by a deep fissure, which divides the plate, without injuring the fabric; on the right side near this channel the anus debouches; the pedal plate is then continued to the posterior end, becoming wider, and there, as before stated, it is reflected on the posterior part of the shell.

It appears then that there are but two lobes, the upper or tentacular, and the pedal one, which though interrupted by the deep groove, is in reality a single plate, but from its posterior and anterior lateral reflexions, together with the tentacular disk, gives the animal the characteristic quadrilobated appearance of the tribe. The object of the pedal fissure is probably to give flexibility to the foot, and allow the lobes to act as fins, as the animal is equally an adept in natation and reptation.

Twenty years ago I observed hundreds of these creatures swimming and creeping on the fine mud in the lakes of the Mount Pleasant Warren near Exmouth; they however suddenly disappeared from the locality, and not one has been seen for many years; the animals now described were obtained near Swanage, Dorset.

The large circumferential canal of the separation of the upper and lower lobes is much more decided on the right than on the left side, as from the former we have a view of the orifice of the verge, the open seminal duct, and the common cavity of generation, the testis, and points of the branchiæ. The eyes are very distinct, situate far back on the tentacular

disk, and not very close together; they are black, and sessile in the centre of a minute circular lucid spot: M. Cuvier has overlooked them. The fissure of the mouth is vertical; this is placed in the centre and between the tentacular and pedal disks; and on each side the mouth, within the groove, are two elegant conspicuous leaflets perfectly symmetrical, each consisting of twenty strands on each side the stem, which are largest posteriorly, and gradually diminish until they are lost at some little distance from the buccal orifice by suddenly turning inwards, appearing to pierce the groove and enter the buccal cavity; they are light yellow; the one on the right side is placed just above the seminal groove, the other on the left in a symmetrical position; the strands under the microscope appear to be glandular, without a leading vein or artery; they have the aspect of minute, wiry, dendroid filaments. These organs I should have taken for the salivary glands, if M. Cuvier had not stated the presence of others of a strap-shaped form in another place, and as he has given nearly a similar form to the salivary glands of the *Aplysia*, *Helix aspersa*, and other hermaphrodites, I must defer to such authority. I will return to this point. I have now described all that can be seen without dissection.

The vertical fissure of the mouth is faced by the anterior part of the tongue, which consists of two hemispherical portions, each furnished with fifteen obliquely arcuated yellow, wiry, horny strands, set with short transverse hooks bending posteriorly. This denticular apparatus does not extend through the large, oval, pale red fleshy buccal mass, and is not supported by distinct corneous plates, but by a tough coriaceous membrane. From the posterior end of the buccal mass the œsophagus proceeds straight to the gizzard; it is long, flat, broad and dilatable, accompanied by the two straps described by M. Cuvier as the salivary glands, which are fixed to each side of the anterior and upper part of the gizzard, and run on each side the œsophagus to the posterior end of the buccal mass, to which also on each side they are attached, apparently only to the external surface, and do not appear to pierce it. Under the microscope they have little appearance of being glandular

or tubular, but have the aspect of loose muscular straps; they however spring from two small yellow spongy or granular bodies, situate on the upper part of the gizzard; these I presume are the salivary glands; if so, the straps are the excretory ducts. They lie on each side the œsophagus in the most lax manner: I should have called them œsophageal, gizzard and buccal mass retractors, as they are connected with all these organs, if M. Cuvier had not determined them to be salivary glands; but he is in error in stating, "L'*hydatis* les a très longues, inégales, et celle du côté gauche fourchue par son extrémité postérieure." We have in our cabinet perfect preparations of these organs, and can positively state that they are of the same length, entirely symmetrical, with both ends fixed to the gizzard and posterior part of the buccal mass; they do not float loose, of different lengths and forms, as represented in pl. 2. fig. 14. of M. Cuvier's memoir. Having dissected numerous specimens we are quite sure on this point. Though we admit the straps to be the salivary glands, *sub fide Cuvieri*, still we are much astonished that that great naturalist has not noticed the very visible dendroid leaflets on each side the mouth; we must consider them an additional pair of salivary glands: some mollusca have an upper and lower pair, and these would appear to be more adapted for such purpose than the slender strap-shaped filaments. I can only account for their not being noticed, on the supposition that the glandular leaves in M. Cuvier's specimens must have been so discoloured by the spirit as to have escaped attention. One word more on them: as they are situated exactly at that part of the groove which corresponds with the position of the œsophageal ganglions, it is possible that, as these nervous masses are of larger volume than I ever saw in any other gasteropod, the glandular leaflets may excrete a liquor to invigorate and minister to the nervous influences: this is a mere conjecture: I certainly incline to regard them as salivary glands. Mr. A. Hancock thinks that the leaflets I have mentioned are olfactory organs: I altogether dissent from this opinion.

Having mentioned the nervous system, it may be as well at once to notice it, as M. Cuvier scarcely alludes to it. From

the point where the œsophagus commences at the posterior part of the buccal mass, it has on each side of it two distinct orange or lemon-colour large oval ganglions, each pair being connected by very strong threads, and the under part of the cordon is formed by two minute round orange-coloured ganglions—strange to say, fixed on the posterior part of the buccal mass, and connected by threads with the upper ganglions; these, when *in situ*, form a complete cordon of six medullary masses; from this circle exceedingly strong nervous filaments radiate to the head, the verge, and all the anterior parts of the body. The ganglionic cordon is connected with two large stomachal lemon-coloured ganglions, which are apparent when the gizzard is removed; they are not quite of the same size, the one being bilobed; the other is on the left side; these are removed from the œsophageal collar the length of the œsophagus and gizzard, which is very considerable, but all the masses are connected by nervous threads, which bear being moved and examined by a stylet. The larger ganglion on the right supplies the gizzard, testicle, anus, branchiæ, the common cavity of generation, and also sends a thread to the liver; the smaller one on the left side throws off a filament to the gizzard, and furnishes the heart, liver, bladder, the ovarium and oviduct, with the necessary threads. The gizzard is a strong, tubular, fleshy, cylindrical mass, inclosing three triangular ridged black plates, which grind the aliment down to a pulp; I could detect none in it nor in the intestine in a solid state. I should not omit to say that the gizzard is the stomach, and completely fills the cavity in which it is lodged; the intestine is of very large diameter, arising immediately from the posterior end of the gizzard; it does not form a duodenum of any particularity of shape, but by a crossing or two completes the circumvolution of the liver, being visible everywhere, of nearly the same size, and terminating posteriorly by a short rectum on the right side.

The liver occupies nearly the posterior half of the spire; it is of an intensely dark brown colour, minutely granular, pulpy, without much coherence: at its posterior end is the rather scanty white ramose ovarium, which, when the liver is

well washed out, is easily observed; and from it the yellowish-white wrinkled oviduct, also most visible, springs from the ovary as a slender thread, but as it proceeds it increases rapidly in volume, and then as suddenly diminishes, terminating in the matrix by a fine thread. The matrix and its vestibule is a strong, yellow, tough, tubular subcylindrical organ, with a transverse constriction denoting the anterior chamber; it is, I think, erroneously marked *k*, and called the testes in M. Cuvier's pl. 2. fig. 14. of the memoir. The mistake has arisen from the latter organ lying close, but somewhat posterior to it, and is very different, being of much softer, flatter, more even and elongated form; its colour is pale drab. I think the flat, oval, yellow gland near the bladder and heart, which Cuvier states to be of unknown use, is an appendent to the testis; as I thought I could trace, through the transparent membrane, the excretory duct to the posterior part of that organ.

Since the above was written, additional dissections have assured us that the organ alluded to above, marked *k*, is really meant for the testicle.

The bladder is as large as a small pea, of a pale purplish-red mixed colour; it is nearly globular, and lies on the left side, full of a light pinkish liquid, not acrid but oily, with red-brown specks in it; I have seen similar ones in the ova; its excretory duct crosses from the left side and certainly enters the matrix; it is doubtless a lubricating or an enveloping fluid for the ova; I think it has the latter function; it is never flaccid, but always distended: where is the source of the large mass of fluid? Its external coat appears to be a network of minute vessels, and I presume they are the ducts which distil the secretion from the larger veins. The "organe générateur" when not exserted lies doubled up in the œsophageal cavity; it is of trifid form, that is, finger-, spindle-, and club-shape, which latter portion extends to and lies on the gizzard; there is no internal connection between it and the testis. Of this I am sure, as in consequence of the shape and position of the parts, that fact admits of being accurately ascertained. It may therefore be considered as almost certain, that the long,

slender, open groove, which by the muscular contraction of the sides can be closed so as to form a canal, extending from the orifice of the verge to the entrance of the common cavity, must be regarded as a continuation of the vas deferens of the testis, which passing under the matrix, or through it—which of the positions is doubtful—unites with the open canal that terminates at, but does not pass into, that organ, and thus the vivifying influences are enabled to make the necessary contact. M. Cuvier's figure of the branchial plume presents a vertical and partly horizontal face. Having examined many specimens, it appears to me to be a single regular crescent-shaped plume of eighteen or twenty short coarse strands, having the artery in the centre, lying in a crypt transversely between the vulva and the anus, floating free, except where under the mantle it is fixed to its roof and to the back of the animal. The heart is oval, white, and with the auricle placed as usual in a pericardium, at the base of the branchiæ. With regard to the veins and arteries I have not attempted to trace them; the circulation is of course complete; but if, as in *Aplysia*, there are any peculiarities attached to it, I do not think that they will easily be detected in so small an animal. There is nothing particular in the muscular system; it exhibits the usual masses of transverse and longitudinal fibres, which throw off from the internal surfaces the necessary muscular filaments. The *Bulla hydatis* may be considered as the type of the general aspect of the anatomy of the family of the *Bullidæ*.

The slight rectifications I have ventured to suggest, even if established, in no way detract from the general accuracy of the great anatomist I have alluded to; if I am right in my suggestions, it is entirely due to having at my disposal numerous living specimens; but M. Cuvier, I infer from his memoirs, had often only one or two indifferent specimens from spirit. His merits and labours exhibit a noble example of what may be accomplished by assiduous application, combined with a mighty genius; he is the pilot and Columbus of modern malacology, and his successors have little more merit than as "imitatores;" for what we know he has taught us, and those who have gone beyond him in the useful

drudgery of detail, must not forget that M. Cuvier, like Newton and Columbus, pointed out the path, and taught them the 'principia.'

B. CYLINDRACEA, Pennant et nobis.

Cylichna cylindracea, Brit. Moll. iii. p. 508, pl. 114. B. f. 6; (animal) pl. V. V. f. 3.
C. mammillata, Brit. Moll. iii. p. 514, pl. 114. C. f. 4, 5.
Bulla mammillata, Philippi.

Animal cylindrical, elongated, convolute; mantle not thick, rarely produced beyond the front and lateral margins of the shell; it is edged with a series of minute red papillæ; the linear posterior accessorial lobe of the foot lies within it, and resting on the columella gives the mantle the appearance of being thickened; the surface of the shell in live and perfect specimens is covered with an olivaceous or orange-brown epidermis.

It is now necessary to make an extract from M. Lovèn's generic diagnosis: "Oculi sub eorum basi immersi; solea brevissima, ovato-quadrata; pallium limbo incrassato aperturam postice claudens." If our views of the mantle and foot are correct, it would appear that the linear posterior lobe of the foot has been mistaken for a component part of the mantle, giving that organ the crassitude mentioned by M. Lovèn. There are no eyes in this species. M. Cuvier ascribes to the genus *Bulla* four tentacula: what are called the superior pair, are, as we think, the posterior lateral flaps of the head-disc, being the floating margins of the solution of continuity of the disc from the neck; the inferior pair are the mere roundings of its anterior part, aided by a narrow circumferential groove and a central indentation, that give the aspect of ears; but neither pair have the similitude or functions of the tentacula of the Pectinibranchiata. The flaps occasioned by the deep sinus, at the *under* part of the foot, are quite as produced as the superior pair of M. Cuvier, and may as well be called tentacula; it is surely a misnomer to call these appendages by that term in any of the *Bullidæ*; their only use seems to be that of fins or paddles to assist in

locomotion, either by creeping or swimming. The head-disc is usually white or pale yellow, of subquadrangular shape; it rests on and covers the foot, which is of similar form, and the central sinuations of the two coalesce. The foot, as in the type, extends from beyond the shell in front to its posterior extremity. At half its length from the front the continuity is interrupted by a deep hiatus, but at a lower level the linear or accessorial lobe progresses to the termination of the shell, lying in the narrow aperture.

This structure has given rise to M. Lovèn's term "solea brevissima:" he has only described the anterior or active part of the foot, or one-half of it, overlooking the posterior linear portion; its apparent separation certainly puts on the appearance of a short distinct subangular foot, sinuated in front. These remarks, I think, explain, if I am not in error, M. Lovèn's mistake relative to the foot and tumidity of the mantle. The division of the foot by the deep groove is doubtless, as in *B. hydatis*, to increase flexibility, and its under marginal flaps, with the upper ones of the head, miscalled tentacula, are probably to assist both pedal and natatory locomotion. The progression of the present animal, though otherwise it is sufficiently lively, often turning from one side to the other, is very slow. The sole of the foot is pale yellow or white, and is often well reflexed on itself at the sides, and sometimes up to the upper disc. The mouth is between the lobes; the fissure is vertical, and furnished with a buccal mass supported by corneous plates and a short spinous tongue. The stomach, as in the typical species, contains a gizzard composed of three minute, elongated, very black, rather pointed plates, flat within, convex without, and all of similar form. The branchial apparatus is a plume of short coarse strands lying in a crypt across the neck. The anus appears to terminate posteriorly, as that portion of the shell is always incrusted with sand, mucus, and fæcal matters. The general aspect of the animal varies from pure white to pale orange-yellow, with occasionally a tinge of green.

It inhabits the coralline and laminarian zones.

This animal has the same leaflets at the sides of the buccal

disc, mentioned in *B. hydatis*, with the groove that is the continuation of the vas deferens; and such of the other organs that could be observed in so minute a species scarcely differ from the type.

M. Lovèn mentions eyes imbedded in the skin; no appliances enabled us to detect them in this species; but whether they are there or obsolete, that circumstance is only specific: *ex. gr.* in *Natica monilifera* the eyes are obsolete, but in *N. Alderi* they are easily seen; the presence or absence of these organs is therefore not of generic value. All the other points being absolutely similar to the type, we are bound to consider the genus *Cylichna* as not applicable to *B. cylindracea*. We have a preparation to show that the linear posterior lobe of the foot lies in the narrow aperture of the shell, agreeably to the invariable characters of the *Bullæ*.

B. TRUNCATA, Montagu et Auct. et nobis.

Cylichna truncata, Lovèn.
C. truncata, Brit. Moll. iii. p. 510, pl. 114. B. f. 7, 8; (animal) pl. V.V. f. 4.

Animal subcylindrical, convolute, flake-white; mantle hyaline, quite plain, extending occasionally beyond the margins of the shell. The head lobe is large, compressed, very slightly auricled, sinuated in the centre, and edged with a light lead-coloured line, which may be the reflexion through the hyaline tissue of the leaflets within the anterior part of the sinus between the lobes, mentioned as conspicuous in *B. hydatis*, and presumed to be seen in the last species.

The mouth is between the head lobe and that of the foot. The animal carries the head rather beyond the foot on which it lies, so that it may be mistaken for that organ. The posterior division of the head-disc from the neck, with the deep central sinuations, give rise to what I call the flaps or fins, which in this animal are more extensive than in *B. cylindracea*, and have the shape of short, flat, triangular pointed fillets, lying like the ears of a hare close to each side of the neck; but when the animal in marching, after having fixed the foot,

draws up the shell to meet the extension, its edges catch and raise them to an erect posture.

The eyes, though not large, are distinct and fixed, in those species in which they are not obsolete, as in *B. hydatis*, and I believe in all other *Bullæ*, at the anterior internal bases of the so-called tentacular processes; they are not raised, but immersed in the surface of the skin: though they and the flaps or fins are in rather an advanced position, they are only seen when the animal is on the march, from its habitude at other times of keeping these organs under the shell; but in those of thin texture they may be seen through it. The foot, as in *B. cylindracea*, is one entire lobe, divided as in the type at the under part from its posterior linear accessory, which also lies within the mantle in the narrow aperture of the shell, by a deep solution of continuity. In this minute creature it is difficult to observe the connection and origin of the accessorial lobe with its principal: the deep groove or rather hiatus between the two portions of the foot causes the anterior division to assume the appearance, as M. Lovèn terms it, of "solea brevissima;" the mistake is very natural; the free floating margins resulting from its apparent division from the posterior lobe, give the appearance of a complete foot. The anterior part of the foot is rather shorter than the head-lobe, ovately subquadrangular and rounded at the front and posterior extremities, sinuated at the centre, grooved around the margin, and not at all auricled. I have observed thirteen of these animals for four or five days in sea-water, but I never saw any reflexion of the mantle; however, the foot at times is considerably reflected laterally on itself and the anterior part of the shell, and in quietude assumes the quadrilobated character of the tribe. The march of this animal is much more lively than in *B. cylindracea*. The mantle forms an anal sinus at the posterior part of the canal of the shell; there is a deep groove between the head and foot-discs. The branchial plume is deposited in a cavity across the neck. The buccal mass is a light fleshy palate, and may be seen through the head-lobe; the mouth leads by a long linear œsophagus to the stomach, situate in the last convolute cavity of the

shell, in which is fixed a gizzard of three very small, dark brown, similar-formed, minutely-dotted, oval, coriaceous plates, which can be seen in action through the transparency of the basal volution.

It appears that the only difference between this animal and that of *B. cylindracea* is, that in this the disc-flaps are more developed, and the eyes are distinctly visible; I therefore consider all the general remarks on the last species, not mentioned to prevent repetition, as applicable to *B. truncata*, which I think is appropriately deposited in the genus *Bulla*. The *Bullidæ*, like the *Helicidæ*, are hermaphrodites with mutual congression, and are oviparous.

Of this section the animals of the following *Bullæ* have not been met with:—

B. LIGNARIA, Linnæus.

Scaphander lignaria, Brit. Moll. iii. p. 536, pl. 114. F. f. 3; (animal) pl. V.V. f. 5.

B. OBTUSA, Montagu.

Cylichna obtusa, Brit. Moll. iii. p. 512, pl. 114. C. f. 1, 2, 3.

B. UMBILICATA, Montagu.

Cylichna umbilicata, Brit. Moll. iii. p. 519, pl. 114. C. f. 9.
C. nitidula, Brit. Moll. iii. p. 515, pl. 114. C. f. 6.
C. conulus, Brit. Moll. iii. p. 517, pl. 114. C. f. 7.
C. strigella, Brit. Moll. iii. p. 518, pl. 114. C. f. 8.

B. AKERA, Gmelin, Mont. et nobis.

Akera bullata, Brit. Moll. iii. p. 527, pl. 114. D. f. 4, 5, 6; (animal) pl. V.V. f. 6.

B. CRANCHII, Leach.

B. Cranchii, Brit. Moll. iii. p. 533, pl. 114. D. f. 8, 9; (animal) pl. V.V. f. 2.

B. HYALINA, Turton.

Amphisphyra hyalina, Brit. Moll. iii. p. 521, pl. 114. D. f. 1, 2; (animal) pl. U.U. f. 2.

** *Testaceous shield concealed within the mantle.*

BULLÆA, Lamarck et Auct. et nobis.

PHILINE, Lovèn.

This section of the *Bullidæ* is represented by the *B. aperta*. As it is an influential type, we have given a full description of the animal.

B. APERTA, Linn., Auct. et nobis.

Philine aperta, Brit. Moll. iii. p. 539, pl. 114. E. f. 1; (animal) pl. U.U. f. 1.

Animal throughout pale yellowish-white, and densely powdered with very minute, intensely white, distinct opake points; its shape, when in action, is subrotund or a broad oval, in which state it has the indistinct aspect of four lobes, but when quiescent, by the reflexion of the lateral parts of the pedal disk, the upper range has the figure of being conspicuously quadrilobated. Above, when on the march, the animal is gently convex—below, flat or slightly concave. The upper lobe, which may be considered the head, as the mouth is at its extremity, is somewhat elongated, rounded in front, truncate behind, without eyes or tentacular flaps, and at about half the length of the animal is broken in upon by a deep transverse groove; it is then continued to the posterior extremity by a thin membrane springing from the furrow of the fissure which envelopes the shell that covers the viscera, and forms the posterior portion of the upper area; this membrane is not strictly a lobe, but merely an envelope to keep the anterior part of the shell in position, the apex being imbedded in the terminal membrane;—M. Cuvier says, unattached by a muscle, which perhaps is doubtful, as I shall show.

The pedal disk, at the same point as the upper, is also deeply transversely grooved, and, like it, there arises an appendix or continuation membrane which secures the anterior under part of the shell; these upper and under posterior membranes are open at the extremity on the right side for the development of several of the posterior organs, but the tissues coalesce on the left, and the free parts have a subtruncate aspect with their

margins sinuated. The body of this animal is therefore composed of an upper or head-lobe and the pedal disk; which, though their continuity is invaded as regards the integuments, are really integral plates from one extremity to the other. The lobes, as in *Bulla hydatis*, are separated by a deep canal, which, except for a very small extent, makes the circuit of the animal, less profound on the left than on the right side, from whence all the organs that are apparent without dissection may be observed; as the orifice of the verge on the right side of the head-lobe, the canal which is probably the vas deferens, or a continuation of it, the common receptacle of generation, the points of the branchiæ, and the lateral leaflets on each side the mouth. To describe these organs would nearly be a repetition of the notes on *Bulla hydatis*; as they are essentially the same, the variations need only be mentioned.

The branchiæ, the common receptacle of the ova, &c., are placed more posteriorly here than in that genus. The leaflets around the mouth between the groove, which I take to be salivary glands, are, as to general shape and position, similar to those in *B. hydatis*; their structure only differs, being composed of close-set, light brown vertical filaments or lines, the extent of which in depth is defined by the width of the canal, instead of being branched. The mouth is at the centre of the anterior part of the canal between the two lobes which assimilate in form about the buccal range, the pedal one more posteriorly expanding into fins or lateral lobular reflections; the fissure of the mouth is vertical.

As to the internal organs of the present species, they are nearly identical with those of *B. hydatis*; the specialties are of the most trifling value; the ovary and serpentine oviduct, testis, the anus, the heart, auricle, vesica, coarse brown branchiæ, liver and intestine, scarcely offer appreciable variations. The mouth, as in *B. hydatis*, is armed with a delicate folding masticatory apparatus, consisting in each jaw of about 12–15 light-coloured, arched, pointed hooks curving inwards, supported by a fleshy buccal mass, which terminates behind in a very short unarmed lingual riband.

The greatest variations are in the number of the nervous ganglions, the salivary glands, gizzard, and the "organe excitateur;" these we will briefly mention. The central flat white retractor of the head and the lateral œsophageal threads are nearly similar. In this species the two principal masses of the ganglionic cordon consist of three distinct pink lobes on each side, instead of two as in its—I had almost said congener, *B. hydatis*; the two minute buccal and stomachal ganglions are nearly similar in shape, position, and in their connection by nervous cords with their primary points of departure. The very strong gizzard, which is the stomach, is formed of three white, testaceous, subtriangular plates, two of which are of the same size and shape, the third or key-plate is smaller, all being pointed at both ends, enclosing a strong brown circular membrane, which receives the œsophagus, from which the duodenum departs. The salivary glands, instead of, as in *B. hydatis*, being very long and springing from the gizzard, are two short corrugated fillets, which originate on each side anterior to the nervous collar, their extremities floating free. If M. Cuvier had not determined these appendages to be the organs of deglutition, we should have demurred to such views, and rather have considered the lateral leaflets around the mouth to be the salivary glands, which, being present in the three species of the *Bullidæ* I have examined, prove that they are not accidental markings, but secreting glands; of what nature is doubtful. The "organe générateur" or "excitateur" greatly differs in form in the two genera, which, however, can only be considered as a specialty, since its function, position, mode of protrusion and retraction, and isolation from the testis, are absolutely the same; but instead of being trifid and comparatively short, as in *B. hydatis*, it is, in a moderate-sized animal of *B. aperta*, at least 3 inches long, slender, or rather filiform, cylindrical, rolled in short folds into an irregular mass, affixed and in connection with the orifice under the right segment of the head, and lying, when inactive, under the anterior part of the cavity of the gizzard; it can be protruded and withdrawn as the finger of a glove can be inverted and again exserted. It

must not be supposed that this appendage is an epididymis connected with the testis, or a vas deferens, as there is a distinct groove for the latter use; it is the organ of reproduction. We have some doubts if the shell of *B. aperta* be without a muscular attachment, as in dissection we have always seen, near the apex of the shell close to one side of the short columella, what appeared to be a delicate flat muscle springing from a subrotund scar; this is contrary to M. Cuvier's dictum. The pedal locomotion is almost imperceptible, and can only be appreciated by the fact that a space has been passed over. The natatory progress is more rapid.

A review of these comparative observations appears fully to support the position, that in all essentials, and in many specialties, this genus scarcely varies fron *Bulla*, and that *Bullæa* is a happy appellation, differing so slightly from *Bulla*, as truly to represent the equally slight variations between the animals of the two genera. We may say that the differences are more apparent than real; the mantellar membrane, passing over the shell instead of under it, being of little importance; in fact, it may be considered a tough epidermis, as under the shell there is a thin membrane of the nature of a pericardium, which may be substituted, without violence, for the visceral enveloping mantle of the typical Gasteropoda. Finally, we would ask, if it would not be conducive to the interests of science, and operate as a practical check to the enormous and useless multiplication of genera and species, to consider *Bullæa* as superfluous, and its species a section of the genus *Bulla*? A re-examination and comparison of all the minute species of both tribes of this family with each other, and with those that have not as yet been seen, may require new genera; but as the case now stands, I think that *Bulla* and *Bullæa* are sufficient. We all must object to the splitting and torturing mere specific differences to fabricate useless genera.

B. CATENA, Montagu et Auct.

B. catena, Zool. Journ. iii. p. 337.

Philine catena, Brit. Moll. iii. p. 545, pl. 114. E. f. 6, 7; (animal) pl. U.U. f. 4.

The animal is an elongated oval; the upper disk, as in the tribe, is essentially an integral plate, though the skin is broken into two apparently well-separated lobes; the anterior one is the longer and narrower oval, and shows no trace of eyes or tentacula; the posterior is broader and shorter, and encloses within the skin an elegant, clear, white clypeiform shell, marked with close transverse catenated striæ; the posterior extremity of this lobe is digitated. The pedal disk extends, without a break, the whole length of the animal, the sides being well reflexed on the upper lobe, giving that surface the quadrilobated aspect of the tribe. Between the two disks, just under the upper one, is a slight inflation, the representative of the head, beneath which is the vertical buccal orifice.

For the anatomy, I refer to my accounts of the *Bulla hydatis* and *Bullæa aperta*; it is the prototype in miniature of those species, as far as can be judged in so diminutive a creature. I couple the *B. hydatis* with the *B. aperta*, as the internal organs of the animals, though of so different an exterior, are essentially identical. The gizzard in this animal presents some difference, being an elastic muscular cylinder cased with three similar-shaped white testaceous trapezoid plates, pointed at the axes. The colour of the upper disk is a yellow ground, closely aspersed with light red-brown minute points, mixed with a very few lines and blotches of similar colours, and some specks of sulphur-yellow; the pedal disk is powdered throughout on a pale yellow ground with rather intense minute yellow points or small streaks. The animal inhabits the littoral zone, at Exmouth, but is rare amongst algæ in the sheltered pools; it is by no means sluggish, and delights in swimming. Longitudo $\frac{4}{10}$, latitudo et altitudo circa $\frac{2}{10}$ unciæ.

This is a reproduction, perhaps not a disadvantageous one, of an account of this animal and the *Bullæa punctata* which

I published in the 3rd vol. of the 'Zool. Journal,' I believe, twenty years ago, and have not seen either it or the animals since; I am therefore in some measure on new ground, and this oblivion is a guarantee that I am not influenced by former impressions.

B. PUNCTATA, Clark.

B. punctata, Zool. Journ. iii. p. 339.
Philine punctata, Brit. Moll. iii. p. 547, pl. 114. E. f. 8, 9; (animal) pl. U.U. f. 5.

Animal oblong oval, having the anterior lobe of the upper disk rounded in front, contracted behind, and in consequence showing its decided separation as to the groove from the posterior one, which is smaller and more subrotund, and contains, as in its congener, *B. catena*, the same shaped white vitreous shield, elegantly striated with oblique lines composed of distinct dots; the posterior lobe bends to meet the pedal one beneath, and is slightly digitated, the left fillet being the largest, from whence the extremity gently obliques in an anterior direction to the right side. The pedal disk is continuous, and meets the bent portion of the upper posterior lobe; it is also exceedingly well reflexed laterally, giving the characteristic four-lobed aspect of the tribe; the canal dividing the disks on the left side, is white and smooth; while on the right, the anus, which is most posterior, then the points of the branchiæ, and lastly, the common receptacle of generation, may be seen, with the spermatic open groove connecting the last organ with the organe générateur; but I need not say more, as all these parts are identical with those of *B. catena*, and are fully described in the references under that head.

The pedal disk is pale yellow, suffused with a faint blush of cloud colour; the upper disk is of a dirty-white ground, but well marked with the finest longitudinal dark close lines, mixed with minute streaks and points, giving the whole area a dark cloud-coloured sombre aspect, instead of the pale red one of *B. catena*. I have a confused recollection that in my former account of this species I stated that I could not find a

hard gizzard, and that it was probably a coriaceous one; if so, I am wrong, as in the only live specimen I have since met with, I saw it, though it is so minute as to be little more than a pin's point; it appeared to have the aspect of a denticulated yellow lingual riband, doubled up in two faces on a minute cylinder: I could not detect the third plate; but as I removed the mass from the stomach, not the head, and from its complete similarity externally with its congener, I cannot doubt that the usual trifid gizzard of the race exists. The mouth is as in the *B. catena*, and the part of the upper disk immediately above it escapes from the general cloud colour in being white. This animal inhabits with the *B. catena*, but is a smaller species, and very free in showing the organs that are visible. I have omitted to say that the eyes and tentacula are altogether wanting. Long. $\frac{3}{10}$, lat. et alt. $\frac{2}{12}$ unciæ.

B. PRUINOSA, Clark.

B. pruinosa, Zool. Journ. iii. p. 339.
Philine pruinosa, Brit. Moll. iii. p. 549, pl. 114. F. f. 1, 2.

This species was discovered by us twenty years ago, but, though sedulously looked for, we have not seen it since, and can only refer to our original account of it in the 'Zoological Journal.'

The following, which are *Bullææ* with us, we have not seen alive:—

B. QUADRATA, S. Wood et nobis.
Philine quadrata, Brit. Moll. iii. p. 541, pl. 114. E. f. 2, 3.

B. SCABRA, Müller.
Philine scabra, Brit. Moll. iii. p. 543, pl. 114. E. f. 4, 5; (animal) pl. V.V. f. 1.

The species not particularly enumerated above will now be mentioned. The *Bulla lignaria* has frequently been received fresh, though not alive, from the Plymouth grounds; the animal does not differ anatomically from the four we have described. The *B. Cranchii* has been sparingly obtained in

the same locality, from the trawlers, of far greater size than the Scotch specimens, but not alive or with the animal; and if any account of it has been published, we have not seen it.

Many years ago we had a jar of the *B. akera* sent from Ireland with the animal, which unfortunately was not examined. Müller—and M. Lovèn follows him—has constituted for this species a separate genus, "*Akera*," with the specific appellation of "*bullata*," but the only account given of the animal is, that a connate mantle, emitting a long filamentous cirrhus, fills the canaliculated groove of the suture. We apprehend this is a mere specific expansion, and if there are no anatomical characters different from those of the type, this genus may be considered superfluous; but as the animal is obtainable, we may hope that an account of it will be forthcoming: the Irish examples are far superior in size to the shells of English localities.

The *B. mammillata* is assuredly the young of *B. cylindracea*. *B. umbilicata* and *B. obtusa*, though common, have not been seen alive by us. Some naturalists have extracted from the former a variety which they call the *B. truncatula*, but we are confident that the *B. umbilicata* and its scion are the "*truncatula*" of Philippi; therefore Montagu's prior appellation of "*umbilicata*" must be adopted. The shells sent us as the *B. acuminata* of Philippi are, if not the young of *Ovula patula*, closely allied to it; but as they do not agree precisely with his figure, the species may be a distinct *Ovula*. We have sufficiently noticed the *B. pruinosa*, "*catena*," and "*punctata*," which are very elegant and distinct species. Is Mr. Alder's *B. quadrata* a subglobose variety of the "*catena*"? The gizzard of *Bullæa scabra* being quite similar to that organ in the *B. catena*, combined with the characteristic chainwork of both, would lead us to suppose that the shell is as much concealed as in *B. catena*, and that it is of the *Bullæa aperta* type, and not of the *Bulla lignaria*.

As for the *Bulla hyalina*, called by some *Amphisphyra*, we shall not be surprised if it turns out that the division of the head-disk from the body has been overlooked; that the scis-

sion of the foot is merely the usual oblique groove in this tribe, which simulates a separation of one part from the other; and that the gizzard in so small a creature has escaped detection. We hazard these conjectures, as the shell differs little from those of the minute *Bullæ*; but as this species inhabits Mr. Alder's vicinity, it would give great satisfaction if so competent an observer would communicate fuller notes of this interesting object. We observe that Mr. Alder states the tentacula of his animal to be "short, obtuse in front of the head and before the eyes." M. Lovèn's description of these organs is discordant, "vibracula brevia, conica, remota, lateralia:" this is an important variation: are the animals identical?

With respect to the minute *Bulla strigella* of M. Lovèn and the *B. conulus* of M. Deshayes, we can only observe, with the authors of the 'British Mollusca,' that they may prove varieties of the *B. umbilicata*. The so-called "*nitidula*," which is in our own collection, having been presented to us as a type by a friend, is, we think, a highly polished (by attrition) *B. umbilicata*.

It appears to us that M. Lovèn's *Cylichna*, lately adopted by some authors, might well be dispensed with for the old typical genus *Bulla*.

OTINA, Gray.

We deposit in this family, *ad interim*, the *Otina otis* (*Velutina*, auct.), a curious and anomalous animal, being apparently as near to the *Bullidæ* as to the *Conovuli*. Though it has not the tentacula of the latter, it has the singular divided foot of *Pedipes*, and the eyes embedded in the disk of the head as in *Conovulus*; and, as in it, there is no operculum, in which point it also resembles *Bulla*, as well as in the absence of true tentacula. The animal appears to be an intermediate link of the two families. It requires, and we hope to give it, a further examination. At present it can only be considered *incertæ sedis*. From the subjoined account, naturalists may form some opinion of its natural position.

O. otis, Turton.

O. otis, Brit. Moll. iii. p. 321, pl. 99. f. 2, 3; (animal) pl. O. O. f. 4.
Velutina otis, Auct.

Animal suboval, auriform, thick, pure white. The mantle does not extend beyond the shell, and its margin is plain; the head is large, very slightly lobed at its left and right points; the buccal orifice is a vertical fissure at the under surface, apparently furnished with teeth, or a short spinous tongue, between the usual buccal mass, of a fleshy palate and corneous plates, which are visible through the pellucidity of the head of the animal, with the œsophagus coasting under the light yellow anterior portion of the shell to the stomach. To add to the singularity of this curious creature, the head is so large, that when viewed through the under part of a watch-glass, if the animal is creeping, it has the appearance of a third lobe of the foot, and actually assists in locomotion. The eyes are large, black, placed on rounded prominences in the centre of the head. Another singular feature is, that not even the rudiments of tentacula exist. The foot is of very unusual structure, being similar to Adanson's '*Pedipes*,' and to that of *Conovulus bidentatus*, the configuration of which was discovered by me many years ago at Exmouth. We refer to the description of the foot of *C. bidentatus*, which in progression and all other points is precisely similar to that of *Otina otis*. The doubtful branchial plume lies under the centre of the mantle, evidenced by apparent pectinations, but the exact form escaped observation. The animal is not more than $\frac{1}{15}$th or $\frac{1}{20}$th of an inch in diameter; yet there is not a point mentioned that admits of doubt, except the precise structure of the branchial organ. There is no operculum.

This animal is found at the roots of the *Lichina pygmæa*, on rocks about three miles east of Exmouth, often in company with *Kellia rubra*. When the animals were placed in basins of water they always made their way out of them, and fixed themselves to a dry spot, as is the case with many of the *Littorinæ*, which almost constantly live in free air. This curious and anomalous creature is entirely dissimilar to *Velutina*, and its natural position is far removed from that genus

CONOVULIDÆ.

This small family, made up of the genera *Conovulus*, *Pedipes*, and *Carychium*, constitutes the *Auriculidæ* of authors. I prefer the former appellation, as some of the species of the latter have not the eyes at the central or inner bases of the tentacula, but are more closely allied to the typical *Helices*; whereas the true *Conovulidæ* are of the Limneadan branch of the Pulmonifera, having the eyes always at the base of the tentacula. This family is undoubtedly closely allied to the *Helicidæ*, and its animals, until lately, have been considered marine Pectinibranchiata; but the Rev. M. G. Berkeley, in the Zoological Journal, vol. v. p. 428, pl. 19. f. 3, has shown that the animals are Pulmonifera, and our descriptions fully support that determination.

This family, and its allies the *Helicidæ*, are so entirely incongruous with those which precede and follow their present position in the main line, that it has been judged expedient to let them stand, but to consider them as an aberrant group. As it is not our intention to do more than allude to the land and freshwater mollusca, I shall confine myself to an account of the only species of *Conovulus*, and that of *Pedipes*, to satisfy malacologists on the respiratory structure, and to remove any doubts that may still remain in respect thereof, as well as on account of their being, perhaps not very inappropriately, regarded as marine amphibious Pulmonifera, that inhabit the sea-walls, oozes, and sedges of the estuaries, where they are often immersed in the flats and pools, from which, like the *Limneadæ*, they come to the surface to breathe free air. These animals, from the position of the eyes and shape of the tentacula, have certainly considerable relations with the Pyramidellidan *Chemnitzidæ*.

I observe, for the consideration of the younger naturalist, that it matters not if one animal is terrestrial and pulmoniferous, and another of marine or freshwater habitat and pectinibranchous — they will take their natural position with

respect to each other, and in the method, as the collective value of the characteristic organs either of one or the other preponderates; for instance, the *Cyclostoma elegans*, a land branchifer, falls into natural position with the marine Pectinibranchiata. And though *Carychium* and *Acme* are Pulmonifera, and the *Pyramidellidæ* Branchifera, still the peculiarity of their organs and shells associates them nearly as closely with the marine as with the terrestrial Mollusca.

CONOVULUS, Lamarck.

C. DENTICULATUS, Mont. et Auct.

C. denticulatus, Brit. Moll. iv. p. 194, pl. 125. f. 3.

Animal inhabiting a spiral shell of 6½ volutions; the first very large and ventricose, comprising ⅘ths of the whole; the others are short, flat, and closely packed, with the apex as much reflexed as in many of the *Chemnitziæ*; it is invested with a lightish brown epidermis, which often forms, at the upper part of the lower volutions, a row of minute, close-set, hairy papillæ, with a short filament proceeding from each; these are very caducous.

It is curious that the reflexed apex, or the fold within the aperture, invariably produces an animal with eyes immersed either at the centre of the bases, or more usually at the internal angles of the tentacula; for instance, this is seen in *Conovulus*, *Pedipes* and *Carychium*, *Tornatella*, *Chemnitzia* and *Eulima* and in the *Limneadæ* that have a certain connection with the *Conovulidæ*, as most of them have more or less developed folds on the columella, and show the same tendency to a basal position of the eyes.

The mantle is even with the shell, thick, and fleshy; the neck is very long, often far protruded, and forms beyond the tentacula a very elongated muzzle, which expands into a large subcircular, arcuated, bilobed emarginate disk, with the buccal orifice in the centre quite beneath, and cloven vertically and crosially: this is the head, which is always in advance of the foot: there are no neck-lobes, but two very small suboval head-lappets may be observed near the terminus. The tenta-

cula are short, contiguous, thick, almost conical below, a little flattened above, and blunt; the eyes are dull, large, and immersed at the internal bases; the neck, muzzle and tentacula are more or less brindled with lines, points, and transverse blotches of dark lead-colour. The foot is elongated, thick, rather narrow, rounded at the posteal extremity, and also nearly as much anteally, having very obsolete auricles; the sole is perfectly plain, without even a longitudinal line in the centre, and not a trace of the conspicuous transversely-grooved foot of the next genus and species, the *Pedipes bidentatus*; it is marked with dark-coloured lines above, and is yellowish-white beneath; the pedicle of attachment is very long, extending nearly throughout the range of the neck to the head.

That this animal breathes free air is placed beyond doubt. I distinctly, repeatedly, and without difficulty observed the dilatation and closure of the respiratory perforation at the upper angle of the outer lip, precisely as in *Helix*, and within the aperture the rectum is visible, from which the issue of fæces was seen, as also the network of a part of the branchial vault; thus confirming my observations and conjectures on the closely allied genus and species, *Pedipes bidentatus*, described below, and recorded in the Annals of Natural History, vol. vi. p. 446, N.S. This result was obtained by having consigned to me, by Miss Cutler, a distinguished naturalist at Budleigh Salterton, some fine *C. denticulatus*, full $\frac{1}{4}$ of an inch long, being three times the size of the *Pedipes bidentatus*, from which I drew my first conclusions. These specimens were taken in company with the *Rissoa ulvæ*, but were very rare, from *Bostrychia* growing in a salt marsh near that place. The animal was the ventricose variety.

This species differs greatly in contour, usually becoming ventricosely fusiform as it diminishes in length. The examples observed had three columellar plications, the upper one the smallest, and a longitudinal callus within the outer lip, and one or two rudimental denticles. The locomotion is not so active as in *Pedipes*. The general aspect of the animal is decidedly dark, whilst that of *Pedipes* is nearly hyaline white. Its reproduction is in all probability effected

by the mixed hermaphroditism of the *Helices*. We refer to the *Pedipes bidentatus* for the other organs; they are so similar as to dispense with a repetition. This is the typical and only species of the genus.

PEDIPES, Adanson.

P. BIDENTATUS, Montagu et nobis.

Conovulus bidentatus, Brit. Moll. iv. p. 191, pl. 125. f. 1, 2.
——— *albus* et *erosus*, nonnull.
Auricula bidentata, ibid.

Animal spiral, with a white, glossy, short, fusiform shell of four volutions, and an elongated narrow aperture. The colour throughout the external organs is hyaline flake-white, except that occasionally the termination of the muzzle and lobes of the head-veil are margined with a fine red-brown line. The mantle is fleshy, and sometimes extends rather beyond the aperture of the shell; when it is viewed in the dead animal, it has the aspect of the rounded tumid margin of the *Helices*. The neck is proportionately longer than any other animal of its size I am acquainted with, and at its termination forms a veil divided by a sinuation in its centre into two arcuated lobes, from the right and left angles of which two very short, flat, setose tentacula spring; these vary, being in some animals more cylindrical: a little behind their origin the large subrotund eyes are seen, somewhat within the internal bases; these appear dull, being imbedded in the skin. Beneath the neck-veil a narrow, flat, rather taper, grooved muzzle issues, within which the buccal mass, with high powers, may be seen in action, though neither the tongue nor the corneous plates could be detected. The muzzle rests on the foot, which always outruns it a little; it is therefore between the neck-veil and the foot that this organ anteally forms two curved lobes, caused by the deep indentation in its centre. The pedal disk is moderately long and rather broad, divided transversely very deeply at a third of its length; the other two-thirds taper gradually to a moderately rounded termination, sometimes slightly emarginate and with a medial groove; the pedicle of

attachment to the body is long and slender. The structure of the foot is that of *Pedipes*. I observed it twenty-five years ago, and its quality of locomotion perfectly agrees with the etymology of that term; it is very slow, in consequence of a double action of the pedal disk being necessary to effect progression, the anteal portion being first carried forward, accompanied by the head and neck; it is then fixed, when the posterior portion carrying the shell is drawn up to its predecessor or *pes pedi*, and so on, and thus a slow march is accomplished. There is no operculum. The neck, from the length of its protrusion, admits of close examination, but no generative organ was observed. I think that, from all the fourteen specimens having ovaria, they, like the *Helices*, are hermaphrodites with mutual congression. The sac of the ova is deposited in the posterior cavity of the shell, which part is without internal spire; the animal appears to have the power of absorbing the septa; the oviduct winds, entwined with the brown liver, accompanied by the intestine, to its termination at the middle of the right side of the aperture. The intestine is by far the most conspicuous organ of the viscera; it is very large and always fully distended; its course, after leaving the pylorus of the bursiform stomach, is along the left side, glued to the liver; it descends to nearly the ovarian bag before it ascends on the right side of the liver to its termination at the middle of the aperture, where the fæcal matters may be seen to issue, not in distinct pellets, but in large cylindrical-formed brown sandy masses; the rectum is a mere aperture, but, like the intestine, of large calibre; there are two slight sigmoid flexures, otherwise the form and course of the intestine and its formed contents are very similar to those parts in *Helix*; the œsophagus is long; but though we could not detect all the organs of the buccal mass, we found at the usual place the nervous cordon of two oval yellow ganglions.

I now come to the most important point of this examination, the character of the respiratory organ, as some malacologists are still in doubt whether the animal breathes pure air or extracts it from water; my own prepossessions have been of the latter cast. Having submitted fourteen live ani-

mals to the powers of an excellent microscope, I am enabled to say, that I found no traces of a regular pectinated membrane; but when the dissection turned out well, there appeared, as in the *Helices*, what I considered to be the respiratory cavity, having its walls lined with an anastomosing network of vessels; one side of this membrane abutted on the rectum and the canal of the sac of viscosity. The strongest support that this is the true respiratory organ is, that I observed in several individuals large cylindrical masses, not pellets, of red-brown sandy fæcal matters, ejected from a dilatation in the mantle lining the aperture. It must not be supposed that I have mistaken this orifice for the termination of the rectum: that organ ends within the mantellar dilatation, exactly as in *Helix*, in which the respiratory orifice dilates to receive air as well as to emit the rejectamenta. This dilatation in the present species has not the aspect of the terminus of a rectum; it is a simple oblong fissure, which instantly closes and is lost to view when the fæces are passed. The continual change of posture of these animals, not one of them $\frac{1}{8}$th of an inch long, prevented my observing the periodic dilatations. The facts I have stated appear to be decisive that the animal respires free air; in addition, it has the cord-like margin of the mantle, as in the *Helices*, around the aperture of the shell, and the figure and course of the large conspicuous intestine is also as in *Helix*.

The animal when put into water instantly escapes therefrom, apparently with the view of breathing free air. All the animals exhibited the ovary: this circumstance almost amounts to proof, that they possess a similar hermaphroditism to the *Helices*, that of mutual congression. Those I examined inhabited a bank wall, that for ten days out of thirty is covered by the sea for three or four hours out of the twenty-four; they are found lying at the bottom of stones which are imbedded in a red sandy soil, and have not been disturbed for years; the detached stones at the base of the wall under which they are found are buried from 3 to 6 inches, and require force to raise them.

The fact that these animals are submerged for only a very

small part of the year proves nothing as regards the plan of respiration, as the *Rissoa ulvæ* and minute *Littorinæ* adhere constantly to the outside of the bases of the stones under which the *Conovuli* are found, and are not more submerged, and yet these animals are decided Pectinibranchiata, which nevertheless appear to have the power of living in free air with almost equal facility as the Pulmonifera, and perhaps, by constant exposure to the atmosphere, their branchiæ acquire the capability of extracting oxygen therefrom. Though the *C. bidentatus* are so little submerged, the places they lie in are always humid from the influences of the tidal waters.

Before the *Conovulus denticulatus* had been met with, we had placed this animal in that genus, but the foot of the former being, by its integrity, so very different from the transversely divided foot of this species, together with the curious locomotion, have induced us to substitute Adanson's *Pedipes* for *Conovulus*. Since the above was written, the occurrence of very large specimens has assured us, as fully as in *C. denticulatus*, that this animal in like manner breathes free air.

PTEROPODIDÆ.

This family embraces the *Pteropoda* of Cuvier and Lamarck. We refer to the analysis of our classification for the reasons why this division is reduced in our method to a simple family of hermaphrodite animals with congression, of the Cryptibranchiata; which branchial division receives those animals that have the respiratory apparatus deposited in distinct furrows or crypts in various parts of the dorsal region, and in that respect differ, though not very essentially, from the Cervicobranchiata. *Hyalea* and *Spirialis* are the only British genera; but the species, of which only unique specimens have occurred, are so obscure as almost to baffle description. The *Spirialis Flemingii* is the exception, which is not uncommon; but the recorded accounts of all the animals are so scanty and unsatisfactory as to afford little information.

These shells appear not to have occurred south of the Tweed; indeed the family, as the learned authors of the 'British Mollusca' observe, is almost without the pale of British malacology.

Since this was written, I have learnt that *Hyalea* is an exotic genus.

SPIRIALIS, Eydoux.

S. Flemingii, Forbes.

S. Flemingii, Brit. Moll. ii. p. 384, pl. 57. f. 4, 5, and iv. p. 258; (animal) pl. M.M. f. 1, and pl. U.U. f. 4, as *Peracle*.
S. MacAndrei, Brit. Moll. ii. p. 385, pl. 57. f. 6, 7.
S. Jeffreysii, Brit. Moll. ii. p. 386, pl. 57. f. 8.

Dr. Fleming discovered this species on the Scotch coasts, and it has been taken by Professor Forbes on the south-west coast of Skye. For some account of the animal, see the Appendix of the 'British Mollusca,' vol. iv. p. 258.

This is a variable species as to contour, being subject to more or less elongated and depressed phases of the spire, which have caused two of the varieties to be mistaken for distinct species.

TROCHIDÆ.

This ancient Linnæan family comprises the British genera *Trochus*, *Phasianella*, and ? *Scissurella*. The distinguishing typical characters of the animal are the amplitude of the operculigerous lobe, its various fringes and tentacular filaments. *Phasianella*, in the operculum, does not conform to the normal circular figure, and is not a strict Trochidan; it probably forms the passage from that family to the *Littorinidæ*. The *Helix subcarinata* of Montagu, being the *Adeorbis*, nonnull., is admitted provisionally as a *Trochus*; it is singular that the animal has escaped every naturalist's research, yet the shell is common in the coralline district, but without the animal or operculum. I have frequently found, in company with it, a beautiful, minute, testaceous, multispiral,

circular object, which appears to be an operculum; this by some is considered an Annelide — I think erroneously — as from its texture and sculpture I take it to be the lid of this species. The animal is an important desideratum. The position of *Scissurella* is little better than a conjecture; it is a wanderer between *Trochus, Ianthina* and *Haliotis.*

We divide this group into two sections, the conically elongated and non-umbilicated shells, and the discoidal perforated ones; merging in the latter the genus *Margarita* of authors, and the species of the genus *Skenea,* nonnull., most of the animals of which have been discovered and described by us as *Trochi,* except the so-called *Skenea planorbis,* which we consider a discoidal *Rissoa;* and as there is no sufficient description of the animal, one is supplied in the observations on the *Rissoæ,* that naturalists may judge of the propriety of this position. The *Skenea nitidissima* is almost beyond doubt Philippi's *Truncatella atomus.* The ? *S. rota* may be a variety of the "*atomus,*"—some naturalists think so; we have at times almost been of opinion that it, or a very similar object, is the terminal coil of the *Cæcum trachea,* on which more will be said hereafter. As for the *Skenea serpuloides,* which is the "*divisa,*" nonnull., the *S. Cutlerianus,* mihi, *S. lævis,* and excepting the very doubtful *S. costulata,* we have proved them to be Trochidans; therefore the *Skeneadæ,* a family of past times, having fulfilled its provisional functions, is now only mentioned to account for its old constituents.

This is perhaps the proper place to relate a curious circumstance respecting the *Trochi,* which have hitherto, by Cuvier, and I believe by all naturalists, been considered as bisexual; which reproductive plan, as regards them and all the genera I have examined that have *circular spiral opercula,* is shown below to be of very doubtful determination; and we think it not improbable that, with the genera *Cæcum* and *Turritella,* which we have deposited in our new family of the *Vermetidæ,* and the freshwater genus *Valvata,* they will prove congressional pectinibranchous hermaphrodites; and as all have the circular spiral operculum, they will form a very natural, though an aberrant, group of Pectinibranchiata.

It appears, if there be no error, an unaccountable condition, that all pectinibranchous animals having *spiral circular opercula* should be hermaphrodites, whilst those of the same respiratory structure, with opercula of *every other shape*, should be bisexuals. It would be a loss of time to attempt to explain what is inexplicable; we refer to, and must rest on, the anatomical details at the conclusion of the descriptive notes.

* *Conical, and not umbilicated.*

TROCHUS, Linnæus.

T. GRANULATUS, Born.

T. granulatus, Brit. Moll. ii. p. 499, pl. 67. f. 7, and pl. 68. f. 3; (animal) pl. D.D. f. 4.

Animal inhabiting a conical spiral shell of white or pink colour, furnished with close-set circular moniliform striæ. Mantle plain and even with the aperture. The head is a long, thick, smooth elongated muzzle, yellowish-white, marked with fine longitudinal pale red-brown lines and points, and at an eighth of an inch from the termination clothed with an excessively close-set, very fine white fringe, that falls over the anterior part of the head like hair, which is scarcely visible without being floated, giving the buccal disk the appearance of being deeply sunken; it is striated with brown lines, vertically cloven, and contains a pair of oval greenish-white horny laminæ, supported by fleshy plates, between which the very short lingual riband passes to the œsophagus. The tentacula are long, tapering, pointed, rather flat, and marked above with a longitudinal central brown line, yellow beneath; the eyes are on short distinct external offsets, the cornea being dark blue with a black pupil. The head-lobes are very small, lateral, close to the inner angles of the tentacula, and are mere partially-cloven white fillets; the neck-lappets form two large, pendent, sinuated, slightly scalloped, yellowish-white membranes, of similar figure, not differing as in some species. The foot is very large, extending beyond each end of the shell, anteriorly subtruncate, dilated at the external angles, and tapering to a lanceolate posterior extremity, which is marked

with a red-brown narrow longitudinal medial line; when fully on the march, it loses the auricular angles, becoming posteally narrowed and elongated into a sharp point: the edge of the main sole is clothed with a short, close, exceedingly fine white fringe, only visible in water by the aid of a good lens; it is an error to describe it as crenated; the colour beneath is yellowish-white, above lemon-yellow, sprinkled with irregular fine brown lines and points. When not in extension it has a papillose aspect, but in full action appears divided by fine anastomosing lines into irregular lozenges, resembling coarse shagreen: from the upper surface a membrane or lobe springs, carrying its walls erect, on which, at some distance from its posterior origin, is imbedded a circular multispiral corneous operculum, having the close-set striæ of increment crossed by fine oblique lines; the accessorial lobe then pursues its course on each side the main foot to nearly the anterior end, the margins being clothed with strong, rather coarse white fringe; and in addition, on each side, there are four longish, cylindrically tapering, pointed, equidistant white vibracula, that issue from a tubercular sheath, into which they can be partially retracted; these appendages are in constant motion. The internal organs present no unusual peculiarity, except the reproductive elements and branchial plume, which, as they offer some anomalous points, will be mentioned at the end of the specific descriptions.

This beautiful creature is an inhabitant of the coralline zone, at Exmouth, very rarely appearing in the littoral or laminarian limits; the pure snow-white variety is occasionally taken at the same place. Our remarks are perhaps too diffuse, but this species is selected as the type of this section, though, from the similarity of the tribe, almost any other would have served.

T. ziziphinus, Linn. et Auct.

T. ziziphinus, Brit. Moll. ii. p. 491, pl. 67. f. 1–6.

The animal inhabits a strong, conical, brown or white shell of 6–8 spiral, smoothly striated volutions. It is nearly similar to the *T. granulatus*; the principal variations are in the foot

and head-lappets; the former, though nearly as long as in its congener, and as finely fringed, is much narrower; like it, there are the four vibracula on the upper lobe, the same marginal fringes, and a multispiral operculum of exactly similar aspect. The other variations are those of colour, the foot being on its upper surface dark mottled brown, and smooth, instead of papillose, citron-yellow, and with anastomosing lines; beneath, instead of being white, it is flesh-colour in the centre, shading into pale drab at the margin. The front portion of the tentacula is dark brown, with a dull, indistinctly defined longitudinal line, not so well marked as in *T. granulatus*; and the pedicles on which the eyes are fixed are rather longer and more slender. The neck-lappets on both sides are large, subrotund, white, symmetrical, plain at the edges, though often sinuated by the action of the animal. I am confident that in this species there are no head-lappets; it is bald, smooth, of a dark brown colour.

This species, with the shell varying in contour and colour, is found most frequently in the coralline zone, but it is also often taken in the littoral and laminarian levels, of inferior size. The English *T. conulus* of authors is only a slender variety of this species; but generally the examples in the cabinets are exotic.

T. Montagui, Gray.

T. Montagui, Brit. Moll. ii. p. 511, pl. 65. f. 10, 11.

As the animal of this species, though its shell is not umbilicated, closely resembles the *T. tumidus*, it is only necessary to point out the variations. The tentacula are thicker, rounder, and decidedly more clavate, sometimes appearing spatulate at the tips, fringed with intenser or closer setose filaments, and the margin of the buccal disk is finely crenated; the head-lobes, instead of being delicately denticulated, are each split into five short, flattish, frosted cilia, fimbriated at the sides; the eye-pedicles are clothed with thick-set setæ, far longer than in the *T. tumidus*; the anterior angles of the foot in both species are furnished with short, horizontal, straight, linear auricles, not so much curved and extended as in *T. serpuloides*

or *T. Cutlerianus*; the general colour is pale bistre, with a greater proportion of flake-white than in the "*tumidus*," and at the base of each tentacular sheath or tubercle there is a minute round brown-coloured spot.

This species is far more rare than the "*tumidus*," and inhabits, with it, the coralline zone, at Exmouth.

I have omitted to say that the neck-lappets are both plain, but of very unequal size; that of the right side is much the largest, and often rolls itself up like a branchial fold; they are both more or less speckled with flake-white spots; the margin of the foot, except the anterior line, is clothed with a short white setose fringe. There are two varieties, one with the volutions much more tumid; both are imperforate. I have examined the animals, but could detect no specific distinction.

T. LINEATUS, Da Costa.

T. lineatus, Brit. Moll. ii. p. 525, pl. 65. f. 4, 5; as *T. crassus*.
T. crassus, Auctorum.

Animal inhabiting a strong, tumid, conically subdepressed, obliquely wrinkled, olivaceous, lineated shell of 5–7 volutions. Mantle even, but the pillar neck-lappet often forms a branchial fold, from which I have seen the water forcibly discharged. The head is a short, broad, compressed rostrum, with a transversely subarcuated, suboval disk, edged with short white fringe, not crenate, crosially cloven and furnished with the usual buccal apparatus; on the upper surface it is closely marked with dark brown irregular lines; the neck is pale brown. The tentacula are long, round, tapering to nearly filiform extremities, ringed with palish purple lines, having the eyes, as in the tribe, on short distinct swollen pedicles. The foot at rest is oval, beneath pale drab, beautifully radiated with anastomosing white lines; on the march it is an elongated oval, rounded at both ends; above, coloured like the muzzle, but of paler hue. The operculigerous lobe is very prominent, almost concurrent with the foot, of the same colour, plain-edged, carrying the usual orbicular multispiral operculum; that is, when it preserves its normal form; and on each side three vibracula, annulated, and of the

same character as the capitular ones. There are two small, very dark, suboval head-lappets, situate at the inner sides of the tentacula. What are called the neck-lappets are only continuations of the operculigerous lobe, the one on the columellar side breaking into 8–10 long dentations; the outer one is plain; both are of a flake-white, mixed with pale green on both sides.

The animal is littoral, and plentiful, though locally distributed.

A singular character is attached to this species, which I have not observed in any other *Trochus*. The animal either casts the operculum, or is deprived of it by the attacks of enemies, perhaps from its own pulli, white masses of which, in the genial season, I have seen deposited on the foot, and they may possibly feed on and destroy it; however this may be, numerous examples are found with the opercula in various stages of development and renewal, but never resembling the original: this is a curious fact, which I can at present scarcely account for on rational grounds. The renewals and reparations form irregular spiral, oblique and elliptical curves, or, instead of the sixteen normal volutions, often only show two grossly spiral ones, as in the *Littorina littorea*. I have many such in my collection. I may observe, that, however the sculpture of the area may be varied, the operculum always retains the circular form.

The species of this section that have not occurred in a living state are,—

T. MILLEGRANUS, Philippi.
T. millegranus, Brit. Moll. ii. p. 502, pl. 66. f. 9, 10.

? T. ALABASTRUM, Beck.
T. alabastrum, Brit. Moll. ii. p. 497, pl. 66. f. 7, 8.

T. EXIGUUS, Pulteney.
T. exiguus, Brit. Moll. ii. p. 505, pl. 66. f. 11, 12.

T. STRIATUS, Linnæus.
T. striatus, Brit. Moll. ii. p. 508, pl. 66. f. 5, 6.

T. CONULUS, Linnæus.
T. conulus, Brit. Moll. ii. p. 495, pl. 73. f. 1, 2.

The *T. alabastrum* may be a development of the *T. ziziphinus*, from climate; it is a Zetland production.

The *T. conulus* of Linnæus, Turton, and Donovan is exotic; what passes for it in British collections is usually a slender, turreted, elongated variety of *T. ziziphinus*.

** *Discoidal, subdepressed, umbilicated.*

T. MAGUS, Linnæus et Auct.

T. magus, Brit. Moll. ii. p. 522, pl. 65. f. 6, 7; (animal) pl. D.D. f. 3.

Animal inhabiting a subdepressed, subturriculated, conical, coarsely striated tubercular shell of 5–6 tumid volutions, lineated with oblique red-brown lines. Mantle even, except that on the right side there is often seen an incomplete tubular branchial fold. The head is a short muzzle, finely crenated at the upper part of its semicircular termination; it is adorned with two suboval, approximating, large and long head-lappets, with white fimbriated fringes at their edges, which often hang over the head; their colour above is pale sulphur-yellow, beneath, striated with vivid pink blotches on a greenish-yellow ground; the neck on each side is pale pink; the muzzle, on the upper part, is branded with dark transverse lines, and is studded, where the head-lappets do not interfere, with five short, thick, distinct white setæ; the buccal disk is yellow. The tentacula are long, rounded, basally tumid, subconical, gradually becoming filiform and pointed; the ground colour is white, ringed more conspicuously on the upper than on the under surface with a compound colour of purplish-brown. The eyes are of turquoise blue, with black pupils, fixed externally on distinct, orange-coloured, tumid pedicles. The foot is a broad elongated oval, painted above with a mixture of red-brown and yellow lozenges, arranged in shagreen fashion; the sole is yellow, partially marked anteriorly with an indistinct medial line, and has a fine white marginal fringe; it carries a well-expanded operculigerous lobe of the same colours, similarly shagreened, ornamented with longer fringe than the sole, and mottled with white and brown patches, having at the margin, at equal distances, three longish, slender, filiform

vibracula, which issue from large white tubercles, clothed with fimbriated white strands at their edges; it also carries, nearly at its termination, an orbicular corneous operculum of only 5–7 spiral turns. The neck-lobes are large and suboval, the columellar one having two or three short, white, pendent strips; that of the right side is plain; they are white, suffused with pale greenish-yellow.

This animal, which is common everywhere, is perhaps the most splendid and gorgeous of the British Gasteropoda, equalling, if not surpassing in beauty, its lovely relative the *Phasianella pullus*. The colours vary much, and of course create discrepancies in the descriptions of authors. The animal is free in showing its magnificent appendages.

T. CINERARIUS, Linnæus.

T. cinerarius, Brit. Moll. ii. p. 516, pl. 65. f. 1, 2, 3; (animal) pl. D.D. f. 1 & 1 *a*.

Animal inhabiting a spiral, conical, ash-coloured, lineated shell of 5–6 flattish volutions. The mantle is lax, but even with the aperture. The head is a short, broad, wrinkled muzzle, indented closely at the semicircular termination, ornamented with a veil formed of two subcircular lobes, almost coalescing, with crenated margins, which, when erected, have the appearance of an awning or semi-pavilion hanging over the disk of the muzzle. The tentacula are long, conical, tapering, subulate, white, and barred or ringed with dark cloud-coloured lines; the black eyes are placed externally, on moderately long, strong, distinct pedicles. The buccal aperture is a vertical fissure beneath the head-disk, and the muzzle contains the usual masticatory apparatus. The neck behind is pale yellow, anteriorly dusky, and the head is barred with close irregular lines and blotches. The neck-lappets are suboval and well developed; that on the pillar side has three or four short, white, thick, subcylindrical pendent fillets springing from the lower margin; the other is plain. The foot is rather a long, large, oval disk, yellow beneath, brindled above with dark-coloured, closely packed, undated lines and irregular blotches, and finely fringed at the edge; it tapers behind to a

moderate point. The operculigerous lobe is prominent, and more coarsely fringed than the sole; it carries quite at the posterior end a circular, light corneous operculum with fine spiral striæ, and has the margin serrated; from the base, at equal distances, three long, slender vibracula spring on each side from sheaths, each flanked at the base by two white tubercles, the one blunt, the other longer and more slender. These organs are in constant motion, and can be withdrawn, leaving only the tips visible.

Common everywhere.

T. UMBILICATUS, Mont. et Auct.

T. umbilicatus, Brit. Moll. ii. p. 519, pl. 66. f. 1–4.

Animal inhabiting a subdepressed, conical, strong, purple, obliquely lineated shell of 5–6 flattish volutions. Mantle plain and even. Head a short muzzle, transversely striated with dark cloud-coloured lines, having two very anterior, distinctly separated, small dark lappets at the inner angles of the tentacula, each fringed with about six short white cilia. The head-disk is large, subcircular, white, crenated at the margin, and puckered, having within the usual buccal apparatus. The tentacula are long, round, conically tapering to a fine point, yellowish-white, with dark, dull, purplish equidistant rings; the eyes are on distinct short pedicles. The foot is rounded at both ends, oval, broad, dingy yellow beneath, closely brindled above with dark stripes, margined with fine close fringe, with a medial longitudinal line extending to about half the length of the sole. The neck-lappets are large; the columellar one is fringed; the other is plain, though sinuated; both are yellow, mixed with greenish-flake blotches. The operculigerous lobe has the same colours as the upper part of the foot, clothed with a dirty-white and yellow fringe of variable length, and has on each side three vibracula of the same character as the tentacula; they issue from white tubercular sheaths; and it carries near the posterior end the usual orbicular, multispiral, corneous operculum.

Littoral, and common on all coasts.

T. TUMIDUS, Mont. et Auct.

T. tumidus, Brit. Moll. ii. p. 513, pl. 65. f. 8, 9; (animal) pl. D.D. f. 2.

Animal inhabiting a conical, subdepressed, spirally striated, light brown shell of 4–5½ tumid volutions. The mantle is lax, but ranges with the aperture. The head is a short muzzle, having on its anterior area two small white distinct lobes; the neck-lappets are large and discordant, the pillar one being pale greenish-white, gently scalloped and edged with yellowish flake-white spots; the right or outer one is the largest, white, with a plain margin; the buccal disk is finely crenate at the terminus, with a rayed sunken area of brown lines; the orifice is subcrosial, and within is a minute spinous tongue, supported by white horny plates; the head is marked above with fine transverse dark lines. The tentacula are frosted-white, long, subulate and setose, with large eyes on distinct offsets at the external bases. The foot is narrowish, elongated, rounded anteriorly, with short, curved, free auricles, labiated, tapering posteally to an obtuse termination; its upper lobe carries at the hinder part a circular, multispiral, whitish corneous operculum; its margin is plain, and the surface sprinkled with flake-white streaks; on each side there are three long, white, pointed, equidistant, setose, semi-retractile vibracula, issuing from white tubercular sheaths. The upper surface of the main foot is speckled with dark blotches, and the margin clothed, with the exception of the anterior line, with a short, fine, close-set fringe; the sole is flake-white. The branchial plume is a minute leaf of pale drab. The ovarium is white, and full of ova at this season (July). The organ of reproduction, if it be one, which I now doubt, though I have figured it as such — see 'Annals,' vol. viii. p. 44, N. S. — is visibly exserted under the right tentaculum, as in the other minute *Trochi*.

This elegant species is abundant in the coralline zone, at Exmouth. It is to be considered the type of the minuter forms.

T. SERPULOIDES, (Mont. certè) et nobis.

? *Skenea divisa*, Brit. Moll. iii. p. 161, pl. 74. f. 4, 5, 6; iv. p. 269.
? *S. lævis*, Brit. Moll. iii. p. 165, pl. 88. f. 5, 6.

I present an account of a highly important unrecorded animal, that has long been sought for, not only by the simple malacologist, but by the professors of the science, to settle the apocryphal family of the *Skeneadæ*. To show that its acquisition is very desirable, I need only mention that Professor Forbes did me the honour to request that I would include this minute creature in my researches, as he thought it would in all probability resolve a malacological problem.

Animal inhabiting a discoid white shell of three spiral turns, striated around the umbilicus of the body-volution with fine capillary lines, the upper part of the whorl being plain; it is pure hyaline-white, except the eyes and head-disk. The head is a rather long, broad, finely wrinkled proboscidal muzzle, with a vertical fissure, having a pale red or pink disk, from whence the corneous jaws and lingual riband may sometimes be seen in action, but not so conspicuously as in the *Rissoæ*. The tentacula are long, flattish, frosted on the central line, not irregularly setose at the edges, but most elegantly clothed, each on both sides, with 12–14 long hyaline cilia, arranged in symmetrical series, inclining obliquely from base to point, and diminishing in length in like manner. I have never seen tentacula so elaborately adorned. The eyes are very large, black, and lateral, attached nearly at the external bases on round inflations to the main stems, there being no distinct pedicles: no head-lobes were detected. There are two neck-lappets of different form, the one on the right side being narrowish, flat, and semiserrated; that of the columellar range is shorter, more suboval, and plain. The foot is subtruncate or subrotund in front, superficially labiated, forming at the angles long curved linear auricles, somewhat of the shape of the *Murex varicosus* (*Nassa*, nonnull.), but longer in proportion, thin at the edges of the sole, which is not fringed; it is moderately long and rather obtusely pointed. The operculigerous lobe is also plain, and of the same shape

as the sole, though diminished to be within its margins; it carries near the extremity the circular, corneous, moderately close-set, spiral operculum of 6–8 turns, and on each side, at equal distances, three, not very long nor slender, flattish tentacular filaments issuing from tubercles of the same elegant structure as the capitular ones; these are not vibrated with the usual activity of the tribe, but the curved auricles of the foot may be said to be "læte vibrantes." The verge springs under the right tentaculum; it is flat, pointed, and lies horizontally, nearly extending to outside the aperture, not reflected in the branchial vault. The canal of depuration is visible at the right side just above the first vibraculum; it is a short pendent shoot or cylinder.

This animal inhabits the coralline zone in fifteen fathoms water, five miles off Budleigh Salterton; it is active, marches with quickness, not at all shy, and gave me good opportunities of observing its peculiarities.

It thus appears that the principal differences between this species and its congeners are the mere specialties of the want of distinct eye-pedicles, and the long linear curved auricles of the foot. Axis $\frac{1}{33}$, diameter $\frac{1}{20}$ unciæ.

This very important discovery of a desideratum that has hitherto escaped detection, proves that the animal is nearly a strict *Trochus*, which does not in the specialties show a greater departure from the Trochidan type than is often seen amongst the most classic species. This fact determines the fate of the genus *Skenea*: its provisional members, the *S. Cutleriana* and *S. nitens* of Philippi, called by some authors "*Trochus pusillus*," are in all probability *Trochi*; but I will not venture to say as much of *S. nitidissima*. The *S. lævis* is scarcely a variety of our present species.

T. Cutlerianus, Clark.

? *Skenea Cutleriana*, Brit. Moll. iii. p. 164, pl. 88. f. 3, 4; iv. p. 270, pl. 132. f. 4, 5.

? *S. costulata*, Brit. Moll. iii. p. 167; iv. p. 271. pl. 132. f. 1, 2, 3.

T. testa suborbiculari, albida, aliquantulum producta, anfractibus tribus spiraliter exaratis; striis subtilibus, undatis, transversis,

hic et illic sparsis, notata; sutura simplex; apertura subrotunda, integra, superne in canalem brevissimam desinens; umbilicus inconspicuus, margine columnari paululum obtectus.
Longitudo et latitudo circa $\frac{1}{8}$ unciæ.

The animal at first view exhibits the general characters of *Trochus serpuloides*; the only differences between the two are, that in the now *Trochus Cutlerianus* the cilia of the tentacula and vibracula are less close-set, the curved auricles of the foot much flatter and broader, the foot both anteally and posteally more rounded, and the eye-prominences may almost be called very short pedicles. The animal is infinitely more active, exhibiting a much greater rapidity of locomotion. Operculum corneous, with three or four lax spiral volutions.

I have done myself the honour to attach to this new and elegant object the name of a lady residing at Budleigh Salterton, Devon, whose services in the various branches of natural history have been of great value: her retiring disposition would have declined, if she had known it, even this small tribute of consideration, and mention of qualifications of no ordinary stamp.

T. NITENS, Philippi et nobis.

T. pusillus, nonnull.
————, Brit. Moll. ii. p. 534, pl. 73. f. 3, 4.

The same difficulty in distinguishing the specialties of this species from those of the two preceding ones exists. I can only say, that the tentacula and vibracula may not be so long in proportion, the foot shorter, broader, and more rounded in front and behind, with the curved auricles more free or less attached to the anterior line of the foot, being only amalgamated with it by a broadish central lobe of union, than in either of the others; the eye-pedicles may also be more pronounced than in *T. serpuloides*, but less so than in *T. Cutlerianus*. I never saw three animals so similar, malacologically, with the hard parts so decidedly differing in most respects. I may say that this species has four lateral vibracula, and it is possible the other two may have the same number. In these very minute beings, from their continual change of

position, we cannot always arrive at facts with certainty. My own impression is that all of them have four vibracula; but, however this may be, in a generic point of view it is of no moment. Operculum as in *T. Cutlerianus*. This is the minutest animal of the three, and by far the most active; thus again showing, as I formerly observed in the 'Annals,' on *Cæcum glabrum*, that nature, as she diminishes in volume, usually accompanies that condition with an equivalent of increased energy and activity.

The remaining species of this section that have not been examined are—

T. UNDULATUS, Sowerby.

T. undulatus, Brit. Moll. ii. p. 528, pl. 68. f. 1, 2, and pl. 73. f. 5, 6.

This is the *T. carneus* of Lowe.

T. HELICINUS, O. Fabricius.

T. helicinus, Brit. Moll. ii. p. 531, pl. 68. f. 4, 5, and pl. 74. f. 10; (animal) pl. C.C. f. 4.

T. SUBCARINATUS ? Mont. et nobis.

Helix subcarinatus, Mont. et aliorum.
Adeorbis subcarinatus, Brit. Moll. ii. p. 541, pl. 68. f. 6, 7, 8.

We think this species, when the animal is discovered,—which has hitherto evaded every research,—will prove to be a *Trochus*.

We believe that the ? *Skenea costulata* of the 'British Mollusca' is only a worn *T. Cutlerianus*, with the spiral lines rubbed smooth or faintly impressed and scarcely visible, which in live specimens is often the case; the ribs across the volutions are only the bifurcating striæ thickened by the action of the atmosphere; these striæ prevail more or less in every specimen. If the figures of the two in the 'British Mollusca' be examined, their identity will be apparent.

If it be objected that the preceding descriptions are wearisome, I admit that they are so, as a consecutive whole; but it is not fair thus to look at the question; each object must be

regarded as isolated, and if it is to be described at all, it ought to be done minutely in order to be correct.

I prefer the finished painting to the crude outline, and so with an animal or shell. I repudiate the meagre lists of family, generic and specific names, devoid of description of the object; yet we find such dishonest stuff sufficient to qualify its authors to head with their names a family, genus, or species, or at least to figure as the "fortemque Gyan, fortemque Cloanthum," in the serried ranks of worthless synonyms.

Generalization of masses of objects of natural history is always a failure; the result is confusion and loss of identity; and though now and then an epithet too many may occur in specific description, in such case a fastidious criticism may perhaps be dispensed with.

I have reserved until the termination of the descriptive notes, my remarks on the branchial apparatus and reproductive organs of the *Trochi*, as I hoped, in a very few words, contrary to my own doctrine, to generalize on these points. I am disappointed; some anomalies have presented themselves which require further investigation. The branchial plume of the larger *Trochi*—I cannot speak of the minuter, as they escape observation—are acutely pointed anteally, increasing in breadth posteally, to their arrival at the region of the pericardium. In most other Pectinibranchiata the reverse is the case; but perhaps this structure has a connection with the reproductive organs. The plume is usually long, tapering like a leaf to a fine point, and composed of one or more rows of short, drab-coloured, close-set strands, accompanied, we think, in some species by the rudiments of mucous fillets.

As regards the reproduction, I believe that the sexes of the *Trochi* have always been considered distinct in each individual; M. Cuvier states so; but I have failed to discover in the usual position, except in the very minute species, an exserted male organ, or a retractile one in the branchial vault, or stomachal cavity: the only organ that I can find, that has the least similitude to a male appendage, is a narrow, white, tough, gently arcuated, pointed filament, lining or attached to one of the sides of the branchial leaf, from base to point.

This is a very unusual position, but it may be the right one, as I think I have seen at its base the point of issue of the vas deferens. Under these peculiar circumstances, how is the necessary contact effected? It will appear below, that there is reason to think all the *Trochi* are invested with that modification of hermaphroditism which requires mutual congression, as in *Helix*.

To support these views, or rather conjectures, of hermaphroditism, I have to observe, that besides the organ presumed to be the male *générateur*, which is never absent in the larger *Trochi* that admit of examination, I have, in numerous examples of *T. tenuis*, *T. ziziphinus*, and in at least a hundred and fifty *T. lineatus*, as well as in *T. cinerarius* and *T. umbilicatus*, invariably found the cloven orifice of the matrix placed below the rectum, the canal of which passes partly under and around the sac of viscosity to the ovarium in contact with the liver; and on the side of that viscus, more posteriorly, there is an elongated, subconical, yellowish-white mass of much firmer consistence, which I take to be the testis. If there be no error in what we have stated, we must consider the *Trochi* as hermaphrodites, and a transition-group from the *Patellidæ* and *Helicidæ* to the strict bisexuals. In addition I may state, that on forty or fifty *T. lineatus* being immersed in warm water, all discharged a mass of ova, forced from the matrix prematurely. To test this fact, I put as many *Littorina littorea* under similar discipline, and only the females ejected ova. It is necessary to mention that in the minor *Trochi*, viz. in *T. Cutlerianus*, *T. serpuloides* and *T. nitens*, there is a rather long, flat, smooth filament, which, until the present discovery, I considered a male appendage, horizontally exserted close under the right tentaculum, but which, if the *Trochi* are hermaphrodites, must be regarded as a kind of feeler, and perhaps of similar nature to that I have observed in the same situation in some of the *Rissoæ*; but the larger species do not show such an exserted organ either in a living or dead condition. I am aware that in some mollusca, particularly the *Littorina littorea*, the *organe générateur* is much attenuated, though not to the extent of obliterating all appearance;

but in the examples I have examined of the *T. magus, T. ziziphinus, T. tenuis* and *T. lineatus,* either in or after the genial season, I have failed to discover any other reproductive organ than the one attached to the branchial leaf, if it be one. All this is so opposed to the dictum of M. Cuvier, that the *Trochi* and all the Pectinibranchiata have the sexes distinct, that one cannot help having suspicions that, notwithstanding the strong, almost convincing facts adduced, an error lurks somewhere, though I cannot at present detect it.

September 1852.

Since the above was written I have examined numerous specimens of *Tr. lineatus,* with the same result as above stated; and I have to report in addition, that I think a simple, short and direct oviduct may be traced from the ovary to the canal of the matrix. I have also compared the contents of the ovary with the white masses deposited on the foot, and they are identical. On the left side of the body, in which the testis is deposited, I think the vas deferens may be seen proceeding in a direct line far without that of the branchial artery, to its issue at the base of the organ attached to the side of the plume, which I have presumed is the *organe générateur.*

PHASIANELLA, Lamarck.

P. PULLUS, Mont. et Auct.

P. pullus, Brit. Moll. ii. p. 538, pl. 69. f. 1, 2, 3; (animal) pl. D.D. f. 5.

Animal inhabiting a spiral shell of 4–5½ tumid volutions of singularly elegant variations of colour; mantle grass-green, margin plain. The head is a produced muzzle, truncate, but not cloven anteriorly; the orifice of the mouth is beneath, in the centre of an area marked with fine darkish radiating lines; the back of the head and neck show three longitudinal bars of lead-colour, the middle the palest; the anterior parts have close-set transverse lines of the same colour. The tentacula are long, flat, slender, and setaceous, edged with a brown line; the eyes are at the external bases, on short distinct pedicles, marked with brown and pale green. The buccal

mass consists of the usual palate, and a long tongue, supported by corneous green plates. In the males, on the right side, is a small, green, suboval verge ? The ovarium is of a blue milk colour, entwined with the liver, and full of ova in July. The branchial apparatus is situate as in all the *Littorinæ*, and consists of a single pale green arcuated plume, having at the anterior end numerous close-set transverse vessels, which are long at their commencement and taper gradually to near the pericardium. M. Cuvier states that in his *Phasianella* he found two plumes; I think our only species has but one.

The foot is not trochidan, except the upper lobe; the sole is a perfect elongated oval, as in *Littorina*. The locomotive functions are curious. When the animal marches, one half of the longitudinal area, bounded by a central incised line, is first extended and fixed; the other half is then brought up and in like manner fixed, whilst the first half makes a progression, and so on; thus half the foot is alternately in motion, giving the animal a lateral oscillatory progress. This kind of march is confined, I believe, to this species, and to most, if not all, of the true *Littorinæ* that have the longitudinal scission or depressed line of the sole more or less developed. The sole is edged with a light lead-coloured line, and the upper surface is laterally brindled with semicircular broken pink lines. The upper coriaceous brown lobe at its posterior end supports a shield-like paucispiral operculum, testaceous, and convex externally; it then coasts each side of the foot, having, as in *Trochus*, 2–4 lateral, long, setose, white, sometimes pale red-brown, or pale green vibracula, varying in size, the middle ones being usually the smallest, and finally forms on each side the head a scalloped green, or pale red neck-lappet, furnished with 6–9 plain dentations or cirrhi, which are more developed on the columellar side; the upper lobe throughout is more or less speckled with red and brown streaks.

This animal, in the beauty of its shell and splendid coloration of the organs, is one of the most gorgeous of the British Gasteropoda; the only other animals that can be brought into

competition with it are the *Trochus magus* and *Cypræa europæa*; but the '*pullus*,' when enthroned in a splendidly painted shell, surpasses everything we are acquainted with amongst our indigena. It is a decided littoral species, at times abundant at Exmouth, feeding on the algæ of the lowest levels. It has always been thought phytophagous, but having examined many, we were surprised to find in the stomachs of all a number of minute Foraminifera, amongst them the *Lobatula vulgaris* and *Textularia oblonga*: these objects were whole, and did not appear to have been acted on by the tongue, which is in this species a powerful organ. It is doubtful how the nutriment is extracted; perhaps the gastric juice may ultimately dissolve them.

Though it is the fashion to admit *Phasianella* as a Trochidan, from having on the upper lobe vibracula, we doubt the propriety of this arrangement: first, because it has not the circular operculum; secondly, the sexes are distinct; thirdly, it has the foot and quality of progression of the *Littorinæ*, to which genus I think it has more analogy than to *Trochus*; at any rate it is a transition form; and as *Trochus*, from its probable hermaphroditism, will now precede all the Holostomata, so *Phasianella* will follow it and its associates with circular multispiral opercula, *Cæcum* and *Turritella*,—also probable hermaphrodites.

SCISSURELLA, D'Orbigny.

S. CRISPATA, Fleming.

S. crispata, Brit. Moll. ii. p. 544, pl. 63. f. 6.

VERMETIDÆ, nobis.

This new family, agreeably to my method of classification, is introduced to receive the genus *Cæcum*; and further observations have led me to relieve the British list of the *Turritellidæ*, by a transfer of its single genus, *Turritella*, to this family; which genera, from their close affinity to the hitherto

exotic *Vermetus*, both as regards animal and shell, cannot be placed satisfactorily in any of the groups between the *Helicidæ* and *Pyramidellidæ*. The reasons for this arrangement are so fully explained in the subjoined prologue on *Cæcum*, as to require no further immediate comment; and those relating to *Turritella* will also be found in our notes on that genus.

CÆCUM, Fleming.

This singular genus has long been the reproach of conchologists, and the *pons asinorum* of this branch of science; the greatest names have failed to see its true position; it has run the gauntlet from *Dentalium*, &c. of the Mollusca, to the Foraminifer *Orthoceras*. We do not attribute the satisfactory solution of the problem to any hypothesis of ours, but to time and opportunity, which, almost against hope, presented the living objects of our research. The animal, in essentials, whether it be considered an aberrant *Vermetus*, *Siliquaria*, or *Cæcum*, must in all probability follow *Trochus*, with *Turritella*, as I think these genera will prove hermaphrodites.

At one time we were almost inclined to substitute—but our reverence for priority prevailed—*Vermetus* for *Cæcum*, in consequence of the animal and shell of the two being so much alike. The shell of *C. glabrum*, when very young, like *Vermetus*, forms spiral turns before it commences the elongation; these in *Cæcum*, as well as many of the subsequent portions, as the animal grows and withdraws itself therefrom, fall off, the cylinder above them having been previously plugged up; *Vermetus* does the same, but remains with the terminal spiral attachment. I also believe that the other species, the *C. trachea*, has a right to claim the *Skenea rota* of authors, or an object closely similar, for its spiral turns, in a very young state; in it the three or four epochs of growth are as distinctly visible as in the elongations of the cylinder of the *C. trachea* at maturer ages. Also, under the microscope, the apex of the young *C. glabrum*, the *Serpula incurvata* of Montagu and Walker, agrees with that of the so-called

Skenea rota, and in both, the spire is more depressed on one side than on the other. I may be wrong in this conjecture, but, arguing from analogy, that as *C. glabrum* in the young state has, beyond doubt, a posterior spiral terminus, I may reasonably assume that *C. trachea*, its congener, has also, when young, a spirated extremity; and from the aspect, form, aperture, markings, and general configuration, I shall not be surprised to find that the *Skenea rota* of authors is its spiral posterior terminal portion. I have never taken it except in the deepest waters of the coral district; but some conchologists say that it has been found amongst the littoral *Corallina officinalis*. I think this is an error, and that their object is either the *Truncatella atomus* of Philippi, the *Skenea* ? *nitidissima* of the 'British Mollusca,' or a dwarf *Skenea planorbis* of the same work; with us, *Rissoa planorbis*. Both these are usually smooth; still there are frequent examples with strong, transverse striæ of growth, which at first view resemble those of the ? '*rota*'; but a more careful inspection shows that they are not of the same shape, and the contour and figure of the disk have a different character. We think the learned authors of the 'British Mollusca' have properly separated the two.

It may be objected that the radiating ribs of this minute shell do not accord with the comparatively smooth cylinder of the very young '*trachea*,' nor with the more advanced stages; but it must be borne in mind, that this object is in its sub-embryonic condition, that it instantly changes its character on commencing the elongation, and passes through four or five other diverse phases, until its adult state is completed. In corroboration of this view we state, that its congener, the *C. glabrum*, exhibits similar discrepancies. Of that species we possess the spiral portion united to the elongation, and also without it; the united portions are dissimilar, the spire being quite smooth, but on the formation of the first plug and incipient prolongation, it shows, under a common lens, decided annular striæ, and displays, until adult, alternating spaces of smooth and striated surface. In our specimen of the object ?'*rota*,' there are the same intus-susceptive joinings and divisions as are seen in every *C. trachea*. These

sutures are very different from the whitish transverse lines that are sometimes visible in the *Truncatella atomus* and *R. planorbis*.

However, as we have doubts of the special individuality of the ? *Skenea rota*, we deposit here this apocryphal object, with references:—

S. ? *rota*, Brit. Moll. iii. p. 160, pl. 73. f. 10, and pl. 88. f. 1, 2.

The anatomy and the external organs of the *Vermeti* and *Cæca* closely agree. We have already mentioned, that the incidents of the shells mainly correspond. Notwithstanding these affinities, there are perhaps sufficient characters to separate the genera. Therefore, for the present, we will consider *Cæcum* so aberrant from *Vermetus* as to require a distinct genus.

The *Vermeti* are generally, perhaps always when young, attached to marine substances. The *Cæca*, when adult, are certainly free, but it is not improbable they may be fixed in the embryonic condition; indeed there is reason to think that this idea may be well founded; the excessive rarity of *C. glabrum* in the adolescent state, in which it has the apical coil of 2½ volutions, supports this view. The so-called *Skenea rota* is equally rare, and also corroborates my opinion that the *Cæca*, when young, are fixed, and at a certain age become free, that is, on the formation of the first plug; and we may observe, that before complete maturity a succession of plugs are formed as the animal withdraws from portions of the cylinder, which wither and become decollated; and thus the original spiral coil remains attached to the spot on which it was first cast, and in consequence is rarely met with. In addition we observe, that in the *C. trachea* the periodic pauses in the growth are as well marked as in the *Vermeti*: there are often four equidistant, well-defined rings, some of which have a slight tendency to intus-susception.

The *Vermeti* have been described as possessing four tentacula, but two of them are nothing more than the well-developed pedicles of the eyes, like those of the *Trochi*; and the foot is without an anterior production, the posterior portion

assuming the aspect of a cylindrical plug, with a circular operculum at its extremity. This foot, from the shape and probable fixity of the shell, cannot serve for reptation; but in *Cæcum*, though the foot is regular, it is singularly short both before and behind, and, as in *Vermetus*, carries a circular operculum. Notwithstanding these variations, both animals are simple holostomatous *mollusca*. These differences have been dwelt on, to sanction a generic separation between the two; but we repeat, that their organs, though modified, are so essentially the same, as to create doubt if these variations are more than mere phases of development, arising from the effects of fixation and locality, and in no way invalidate the present arrangement, which we will confirm by additional facts. And first we observe, that *Vermetus* differs very slightly from *Siliquaria*. This remark is made to show that the operculum of *Cæcum glabrum*, our proposed Vermetidan, exhibits the precise features of the same organ in *Siliquaria*, and, like it, is rolled as round a windlass in 5–7 coils, that are crenated at the edges, mammillated above and below, and on the summit has numerous loculi, like those in the centres of the foraminiferous *Polystomellæ*. This curious fact exhibits one of the strongest links of affinity between the three genera. That malacologists may compare the two opercula, we extract M. Philippi's description of *Siliquaria*, which, if it had been written expressly for our *C. glabrum*, could not be more apposite:—

"Operculum valde mirabile, legumini medicaginum simile, cylindricum, uti trochlea e lamella spirali quinquies circa axim revoluta constans. Hæc lamella cornea, subtus nitidissima, supra farinacea subpubescens, margine subtus striolis brevibus subcrenata. Centrum subtus et supra convexum, papillam centralem et loculos plures ostendens, et exactissime Cristellariam s. Robulinam aliquam referens."

The operculum of *C. glabrum* agreeing closely with this description,—and it is in this case a most important coincidence, as these are the only two molluscan genera which have so curious an opercular mechanism,—seems to stamp with certainty the alliance of the three genera.

It would appear that the shells of *Vermetus* and *Cæcum* are more similar than those of *Siliquaria* and *Cæcum*, whilst the animals of the two last have the greater correlation. Though *Cæcum* has not the dorsal fissure in the shell for the water to arrive at the branchiæ, it has, in the marked dorsal carinæ of the animal, an equivalent branchiferous canal; the foot is also more complete in *Siliquaria* than *Vermetus*, and in that respect is nearer *Cæcum*. Considering all these points, I think *Cæcum* has strong claims to be a component of our new family of the *Vermetidæ*, and I associate *Turritella* with it, for the reasons given below.

C. TRACHEA, Montagu.

C. trachea, Brit. Moll. iii. p. 178, pl. 69. f. 4; (animal) pl. K.K. f. 1.

I discovered the animal of *Cæcum trachea*, in the year 1834, in the coralline zones off Exmouth: notes were then made on it, but only communicated to a few friends, and I am not aware that any author has mentioned the animal since that time, except in doubt as to its character and position. Having recently, at the same place, examined many specimens of this curious and minute species, I am enabled to give a particular description thereof, as well as some account of the still more minute congeneric species, *Cæcum glabrum*.

The shells of these animals have, from their forms, long been located with the *Dentalia*, but it will appear that in respect of the animal they have little connection with them; they have also had other places assigned to them, and malacologists are still in doubt with regard to their natural position. I therefore think this account may assist to determine the proper "*locus standi*" of these mollusca.

Animal cylindrical, arcuated, externally pure white. The mantle is very thick and fleshy, fitting the shell closely, and not extending beyond its anterior margin. The body is elongated and slender, with a long, flat, cloven muzzle with fine, close, contractile, annular ridges, which on all occasions is in advance of the foot, and appears to assist in locomotion. The fissure of the mouth is vertical, and from the tenuity of the skin the pale red buccal mass is distinctly visible, the corneous plates

of which are of light yellow and subelliptical form. The tongue was not detected, though, without doubt, one, of the invariable spiny character, exists.

The tentacula are short, rather thick, subcylindrical, setose, and slightly clavate at the extremities; the eyes are very minute, black, not raised on any kind of pedicle or eminence, and placed nearly in a line with the tentacula at a short distance from their bases, and if there is a divergence therefrom, the tendency is external.

The slender neck, as in most of the other Gasteropoda, is furnished with longitudinal ridges; and in this species, on each side of its centre, there are two frosted, pale yellowish-white, contiguous raised lines, forming a very decided canal or groove, the points of which terminate anteriorly at the immediate base of the eyes, and posteriorly at the furthest end of the neck, on the left side of which, at the usual point, may be seen a minute pale red branchial leaflet, which puts on the appearance of there being two, a larger and a smaller one, as in the canaliferous Gasteropoda. But here, though we cannot vouch that there are not two, we are inclined to think there is only one, with a divergence from its base of a part of its surface; the very marked canal seems necessary for the entrance of the branchial water, in consequence of the neck of the animal, when at rest, being so closely embraced by the fleshy muscular circular mantle, but in marching order it is protruded to an extraordinary extent.

The stomach was distinctly observed, and is an oblong bursiform organ, yellowish-white and granular without, but on being opened presents a dark lead-coloured cavity, fortified by strong transverse muscular bands or fillets. From it arises a very long convoluted intestine, which when extracted exhibited the usual fæcal matters; it appeared to coast the liver and ovarium, amongst the folds of which it makes a double, as is usual with the regular Gasteropods, and then progresses to the right side, where the minute, elongated, oval, conically-pointed pellets were observed to be ejected.

The ovarium is dark red-brown, aspersed with very minute darker points, like the finest sand, with its posterior

extremity fixed in the hollowed-out chamber of the terminal process of the shell; it then extends to the stomach, accompanied by the liver in alternate transverse portions; this organ is a light greenish mass formed of larger granules than the ovarium, and the contrast in colour of the two substances caused them to be observed without difficulty.

The neck admitted of a close examination, and did not exhibit the slightest traces of external reproductive organs; it would therefore appear that the animal must depend on its own influences; however, there are doubts; and from the concordance of all its organs with a large class of the Pectinibranchous Gasteropods, it may, like them, be unisexual, though the organs have escaped detection. In all the specimens examined the ovarium was present in the usual place, and in no instance appeared to be replaced by the testicle; but the discriminations of such minute organs cannot be depended on.

The foot is short, narrow, and truncate anteriorly when in action, sloping posteally to an obtusely pointed or rather rounded termination, on the upper part of which end is fixed the strong, circular, corneous, black-brown operculum, smooth and conical on the surface attached to the foot, concave without, and from its centre seven or eight fine close-set *spiral* lines, not concentrical, fill up the area.

The animal is not at all shy; it shows itself in all directions.

The generic term *Cæcum* appears to be somewhat objectionable in point of significancy. On the discovery of the animal I proposed to my friend Dr. Goodall, the late Provost of Eton, the generic appellation of *Dentaliopsis*; but Dr. Fleming is in possession of the field, and has the undoubted priority, and I may say, owing to *my own neglect*, in not launching the genus:

"Hos ego . . . . . feci, tulit alter honores."

C. GLABRUM, Montagu.

C. glabrum, Brit. Moll. iii. p. 181, pl. 69. f. 5.

After a research, in which I almost despaired of success, I had the good fortune to meet with two living vivacious specimens of this species in the coralline zones of the Devonshire

coast, off Budleigh Salterton, six miles from the shore, in ten fathoms water.

To describe the organs of this animal would be a repetition of what has been said on *Cæcum trachea*; I will only recapitulate them and notice the modifications thereof.

The brown ovarium, light green liver, and the rectum with its contents of pale brown pellets, extending from the pylorus to the doubling amongst the folds of the liver, were distinctly visible through the transparency of the shell. The stomach, body and neck were of the purest white; the lines forming the canal or groove in the neck are less developed than in the former species; the buccal mass is of the palest blush colour, and the corneous plates of the most delicate and lightest green. The spiny tongue was not seen; the same default occurred in *Cæcum trachea*, probably from its white colour and extreme slenderness; it doubtless exists. The mantle is thick, circular and muscular, closely fitting the shell; the eyes are fixed precisely as in *C. trachea*; the very minute branchial leaflet is of the palest rose-colour, but the mantle must be removed to see it, owing to its extreme tenuity.

I now come to those organs in which there are some variations. The tentacula, as in its congener, are frosted-white and setose, but they appear to be proportionably longer, slenderer, and more clavate at the tips; these variations however are scarcely appreciable. The foot is very short, truncate in front, rounded behind, and carried much more laterally in this species than in *C. trachea*; and on its posterior upper part is the most differential point in the animals, the curious operculum, which is circular, and has six or seven spiral turns, of a pale yellow; but instead of being concave or flat without, as in *C. trachea*, it is the reverse. Supposing the flat, spiral, circular operculum of the last species, pushed out from its inner surface, or inverted, and thus forming a cone of six or seven minute narrow terraces, one above the other, we then obtain some idea of the form of that in *Cæcum glabrum*.

This creature marches, and in its course performs exactly the same manœuvres, as the larger species. I thought the

Cæcum trachea very active, but it is far surpassed by this animal; I put one of each in a watch-glass of sea-water, and with a camel's-hair brush gave them a fair start, but the little one beat its competitor hollow, and accomplished a space of 2 inches in 55 seconds; thus affording a proof, even in the Mollusca, that nature compensates for the small volume of the minute beings in giving them greater energy, vivacity and quickness. This creature I found by admeasurement to be $\frac{1}{20}$th of an inch long, and $\frac{1}{100}$th of an inch in diameter.

I have been thus particular, as it can fall to the lot of very few malacologists to see this curious species alive.

TURRITELLA, Lamarck.

T. COMMUNIS, Risso et Auct.

T. communis, Brit. Moll. iii. p. 172, pl. 89. f. 1, 2, 3; (animal) pl. I.I. f. 4.

Turbo tenebra, Montagu.

The incidents and peculiarities of this genus, of only one British species, in regard to its connection with the Holostomata and removal to this family, are so fully stated in the subjoined account of the comparison of *Turritella* with *Vermetus*, as not to require further remark.

Animal elongated, inhabiting a brown, spirally ridged, turreted shell of 16–18 tapering volutions. Mantle yellow, loose, ornamented at the upper part with a fringe of the same colour, of seven long and as many shorter strands, the longer ones being fimbriated at both edges, presenting a foliaceous aspect. In *Vermetus*, Philippi says, "mantle entire;" but Sassi, "emarginate." The head is a small, flat, rounded muzzle, which always rests on the foot, yellow, with close-set, transverse, fine dark lines; in *Vermetus* the head is similar. Tentacula rather long, conical, pointed, tumid at the bases, yellow, with eyes at the external angles on only slight prominences; in *Vermetus*, teste Philippi, four tentacula, which however means, as regards two of them, eyes on swollen pedicles, as in *Trochus*. The foot is very short before and behind, scarcely extending to the first volution, yellow under-

neath, mixed with a few dark blotches; the same colour above, mixed with fine transverse black lines; a little truncate in front; scarcely auricled; sloping rapidly posteally to a rounded termination, on which is fixed a closely spirally-striated, circular, corneous, dark brown operculum, dentated, or finely fringed at the edges of the gyrations. In *Vermetus*, the foot, from the animal being fixed, has the anterior and posterior parts amalgamated; the operculum, Philippi observes, "*multispiratum.*" The buccal orifice is under the head, garnished with minute horny rugæ, and within these are two tumid, white, corneous plates, and a short spinous tongue: *Vermetus* has similar organs. The branchial apparatus is a single plume of long yellowish-white pectinations, which have connection with the fringe of the head; above them is a range of coarse strands that appear in miniature, like the mucous fillets of the *Murex undatus*, and, if such, indicate some affinity with the Canalifera. This arrangement is nearly the same in *Vermetus*. On the back of the head and neck there are two raised, white, sinuous, longitudinal lines, running parallel to the branchial cavity, which appear to serve, as in *Cæcum*, to facilitate the passage of the water. The liver is dark green, and is impacted with the light yellow ovarium. When speaking of the foot, I omitted to mention, that its pedicle is very long and strong, and throws out laterally two white muscular straps, which merge in the muscle of attachment of the animal to the shell.

This is a singular animal, being one of the shyest of the Gasteropoda: its locomotion is unknown to me. I have examined hundreds for hours, and never even saw it turn from one side to the other. I have placed it in sand and pebbles, and tried every plan to stimulate its perhaps apparent apathy, but all in vain. Something is wanting in confinement to produce motion: I almost think that it is not one of the attributes of the animal. It never protrudes the head when immersed, but entrenches itself within the operculum: it is only when it has been a considerable time out of water, exposed to a current of air, that the head and foot are exserted. MM. Quoy and Gaimard say of their exotic *Turritella*,

"Cet animal ne laisse pas trainer la coquille comme le font les Cerites et la plupart des coquilles longues; il la relève sous un angle assez aigu, la supporte sur un long pédicule, et s'avance dans une posture peu ordinaire aux mollusques." Though these gentlemen describe a limited and peculiar progression, we have failed to discover one in the British species; I must therefore, for the present, presume that they have scarcely the power of motion, and though perhaps not bodily fixed, as in *Vermetus*, they are virtually so. They are always found in great abundance in a tenacious mud, mixed with shelly debris, that forms zones running between and amidst the deepest waters of the coralline districts, in which I believe they live buried and fixed, and can only protrude the head and tentacula from the mass. These are strong and significant facts, tending to prove the close connection of *Turritella* and *Vermetus*, and, if considered with all that are mentioned above, and those concerning *Cæcum*, will, I think, go far to establish these genera as aberrant and modified developments of the *Vermetidæ*, and as a transition form from the *Trochi* to the *Peloridæ* of our method.

The shell is singular in not having longitudinal ribs or varices, and in this respect is, I believe, only resembled by the *Aclis ascaris* and *Murex teres*. There is scarcely the rudiment of a canal in the aperture, but there are evident marks in all the volutions of successive sinuations in the outer lip, that do not amount to an emargination. In mentioning these points it may be observed, that I have not relied on the coincidence of *Vermetus*, *Cæcum* and *Turritella* withdrawing periodically from the terminal volutions and plugging them up, as I believe all the turreted, elongated, slender species have that faculty given them for the protection of the posterior part of the body.

LITTORINIDÆ.

The following observations by us on this family were published in the 'Annals of Natural History' at four different

periods, and, to show the progress of discovery and rectification, I now present them pretty much in their original form. The first account was written during the summer months of 1849, after an examination of many hundreds, I may say, of nearly all the varieties of *Littorina rudis*, which have long occupied a position as species, to which it will appear they are not entitled.

In close connection with this subject is a very short correspondence between Professor Forbes and myself. I have no copies of my letters, for it has always been an irksome task to me to copy what I write; I trust to memory; and if I have misstated any point, I humbly submit to correction. As Professor Forbes's letter is strictly malacological, I feel confident, from his well-known liberality, that he will not consider an apology necessary for the insertion of the following extract:—

"West Lulworth, near Wareham, Dorset, Nov. 1849.

"I should like to know what opinion you have come to respecting the specific value of the forms of the *Littorinæ* you enumerate. For my part I can only recognize *Littorina littorea*, *L. petræa*, *L. neritoides* and *L. rudis*. I am in doubt, however, whether *L. jugosa* should not also be held distinct."

Being in a position to answer decisively, I wrote to the effect, that having carefully examined nearly all the animals of the varieties termed by authors *L. tenebrosa*, *L. jugosa*, *L. zonaria*, *L. rudissima*, *L. fabalis*, *L. neglecta*, &c., I found them to be identical with each other, and mere varieties of *L. rudis*, and consequently that that portion of the genus *Littorina* consisted, agreeably to his views, of only *L. littorea* and *L. rudis*; I however added, that I believed the *Lacunæ*, not excepting *L. crassior*, were confined to one or two species.

As the genus *Littorina* has long been the depôt of many of its varieties, improperly promoted to species, it occurred to me that a good opportunity offered itself for making a few remarks, with the view of checking, if possible, this inconvenient practice, by pointing out the great detriment that resulted to science from the fabrication of species on insufficient grounds.

I have been wishing for an apt opportunity to issue my paper, which only occurred in the April Number of the 'British Mollusca,' wherein malacologists will observe that Professor Forbes, with singular coincidence, by his views, corroborates mine, written many months ago, from actual examination of the animals. Though the learned Professor has admitted into his work varieties that have not the slightest pretensions to be styled species, for the sake of exciting further investigation of them, yet in page 52 of his summary of the *Littorinæ*, he boldly and emphatically repudiates all paternity with the pseudo-species. He says—

"In the preceding account of the *Littorinæ* several are described as species which many of our ablest naturalists regard as varieties, whilst others are considered as varieties which some hold to be worthy of specific rank; our conviction is, that the result of a completed knowledge of this genus would be a reduction in the number of true British species. Taking the most permanent features of the animal and its shell as our guide, we are inclined to reduce the true specific types to *L. neritoides*, *L. littorea*, *L. littoralis* and *L. rudis*."

My views being thus supported, I send forth without hesitation these observations made long ago, and I feel gratified that my investigations of this tribe have received the corroboration enunciated by that eminent Professor.

Before I give the descriptions of the types of the genera of the *Littorinidæ*, I will make some remarks on the prevalent practice of naturalists to create species from mere varieties: this anxiety can only be attributed to their wish to extend our knowledge of new and interesting objects. That these views are desirable and laudable cannot be questioned, but it is to be feared that the zeal of these gentlemen, combined with the ardour of rivalry in the race with their brethren in the same pursuits, have been the cause of a departure from those principles and laws which are considered indispensable to arrive at just conclusions in the establishment of genera and species; or in other words, in laying down the true bases of the differential features of the families, genera and species

of a class, so as to enable the student to deposit his objects with certainty in their natural position, and to distinguish them from others, however numerous, of the same family, by concise and well-defined specialties. If these rules were rigorously attended to, we should have fewer complaints of the almost impossibility of identifying many of the objects of natural history. The inconveniences that have arisen from the neglect of these precepts are so great and pressing, that I propose to attempt to point out their origin, and suggest a remedy as far as regards malacology and conchology, and to evidence and illustrate my arguments by references to the present state of certain groups of the Mollusca. If conchologists are determined to form numerous species from the same animal because it happens to present certain shell-variations, they must have their way, but malacologists will not concur with them in giving a dozen names to the same object. These gentlemen cannot escape having the phrase "Dies docebit" verified; the day of retractation will assuredly arrive; it will therefore be better for the interests of science and their *amour propre*, at once to apply the remedy for this singular creative monomania,

> .... "O medici mediam pertundite venam."

I apologise for my irreverent quotation, and trust I may claim for this once,

> ..... "Liberius si
> Dixero quid, si forte jocosius, hoc mihi juris
> Cum veniâ dabis."

The practice I have just described is fraught with great detriment to the advancement of science, because in many instances it destroys every attempt at identity, and renders our books bulky and expensive, by the insertion of worthless synonyms, which have no existence as objects; and every writer feels obliged to notice all, because he has not the means of separating the rigorously-defined and well-founded species from the pseudo and unsubstantial articles. It results from this false position of the science, that when a student, with his object in hand, consults the authorities, he finds ten or twelve

others so nearly resembling his, that he becomes bewildered in the mazes of distinctions, often without differences, despairs of identifying his object, and perhaps retires altogether from a rational and highly important pursuit, under the idea that the science is full of perplexities, which he, as a tyro, has neither time nor inclination to unravel.

The unsatisfactory state of this branch of natural history originates in the practice of drawing up specific distinctions from the *shell* or a *half* of the animal; these are consequently arbitrary and artificial; and though, in decided forms, this plan may produce correct results, it signally fails when structures begin to shade into each other; then the sheet-anchor, the animal, can alone solve doubts, and often shows that shells, apparently well marked by specific distinction, are not in reality distinct, and *vice versâ*.

This neglect to consult the most important, the soft parts of the animal, has in some measure been occasioned by the supposed difficulties of procuring living objects for examination, and a disinclination to enter into the imaginary repulsive details of dissection and anatomical inductions; every day's experience diminishes these obstacles. Naturalists may be assured that every attempt to establish specific identity, without taking into account both the hard and soft parts of the animal, will be unsatisfactory and deceptive. The unpleasant operations of anatomy to persons of great sensibility may often be dispensed with, and, in the majority of cases of *specific* discrimination, are unnecessary.

Every person can deposit animals in sea-water and describe their habitudes and external organs, as the head, tentacula, eyes, and how they are placed, whether at the external or internal bases of the tentacula; and if on pedicles, what is their proportion to the length of the tentacula; the shape of the foot, operculum, the mouth, and coloration of the animal, &c.; these points, with the sculpture of the shell, will in almost all cases ensure specific distinctions, and consequently remove the inconveniences of the arbitrary creation of species on conchological bases.

I see with pleasure that the system I advocate has received

a great impulse from that valuable work, 'The British Mollusca,' wherein the learned Professor and his coadjutor have boldly broken through the trammels of the old system, and, as far as possible, founded the classification on natural organization, and at a great expense of arduous research, though still from necessity retaining hundreds of unmeaning and worthless synonyms, expunged and weeded out a multitude of exotic species which disfigured and almost choked up our indigena; these are great services, and every naturalist in this line will feel a lively satisfaction, that by these aids he can now pursue a delightful study agreeably to the order of nature. A new æra has commenced in British malacology; it stands disenthralled from arbitrary and defective dispositions, and in future will march hand in hand with its elder sister, conchology. And lastly, that I may not be misunderstood on the subject of the varieties, I beg to state, that I consider the mention of all very desirable, and of great importance as *varieties*, but not as *species*, and on this point I give an extract from a deservedly high authority. M. Philippi says, "Semper varietates sedulo notavi, hoc etiam valde necessarium duxi, cum auctores qui in musæis modo conchylia describunt, id minus apte facere possint, quam ille qui centena specimina in maris littore ipse colligit et observat; sed nimium plerumque colori, aliisque notis variabilibus, dignitatem tribuant, aut ætates diversas pro speciebus diversis sumant, sicut ex. gr. multoties cl. Risso fecit." This opinion is expressly given *sub modo*, that especial care is to be taken that varieties are not inserted as species.

It now remains to illustrate by examples and impress on the minds of young naturalists the value and necessity of the preceding observations. Perhaps a stronger case of the improper multiplication of species on frivolous grounds cannot be brought forward than that of the genus *Anomia*, which, as I believe, only contains a single British species, the *Anomia ephippium*, the mere varieties of which have constituted the sixteen or seventeen species that are consigned to our conchological annals, and are based on the arbitrary and artificial distinctions of colour, the various adscititious markings, and

forms resulting from the substances on which they are fixed, combined with the influencing effects of habitat, food, and depth of water.

I have recently examined and dissected 500 *Anomiæ* of all forms, sizes and colours, from different habitats, and in the endless variety of colour and markings of this proteiform genus I have not discovered a specific character, either as regards the anatomy or the external organs of this genus, that would justify the creation of a single species. I have now done with the *Anomiæ*, as the learned editors of the 'British Mollusca' have recorded these opinions in their interesting work, though without any particular concurrence therein. But in corroboration of these views I shall adduce some considerations on another genus, which has largely contributed to the increase of pseudo-species; I allude to that portion of the genus *Littorina* designated *L. littorea* and *L. rudis*.

This well-known family, as now constituted, consists of the genera *Littorina*, *Assiminia*, *Rissoa*, and *Truncatella*. The *Lacunæ* of authors are scarcely distinguishable from the *Littorina littoralis*; the animals are all but identical, and the two genera appear to be separated on conchological grounds,—the groove in the columella,—rather than on animal distinction. I think it would conduce to the interests of science if the *Lacunæ* were merged in the genus *Littorina*, and marched *pari passu* with *Littorina littoralis* as species. This view is adopted below, where I shall show, malacologically, that the difference between the animals of *Lacuna* and *Littorina littoralis* is scarcely appreciable. The so-called *Lacunæ* have only one or two species instead of the eight or ten of authors.

Assiminia was established by Dr. Gray, and differs chiefly from the *Rissoa ulvæ* and *R. subumbilicata* of Montagu in having the eyes fixed at the extremities of the tentacula, in consequence of being placed on adnate pedicles of concurrent length.

The *Rissoæ* are very minute; they inhabit the littoral and laminarian zones; the types of the first zone are the *Rissoa ulvæ* and *R. subumbilicata*, and of the second, *R. parva*. These are true littoral *Rissoæ*. Many minute shells, which

conchologically appear to be *Rissoæ*, inhabit only the coralline zones, and as most of the animals are unknown, the true relations between the animals of the littoral and coralline districts are not as yet satisfactorily ascertained.

Littorina has only four species, *L. littorea*, *L. rudis*, *L. neritoides*, and *L. littoralis*.

LITTORINA, Férussac.

L. LITTOREA, Linnæus.

L. littorea, Brit. Moll. iii. p. 29, pl. 83. f. 7, 8; (animal) pl. G.G. f. 3.

This exceedingly common, but very curious and interesting animal, has not met with the attention it deserves; we are sure that we shall afford gratification in producing a detailed account of it.

Animal spiral; mantle simple, exactly lining the aperture of the shell. The head is long, cylindrical, not deeply cloven; mouth a vertical fissure, and with the neck and tentacula marked on their upper surfaces, on a yellow ground, with very close-set, dark transverse lines, which, with the lead-coloured, anastomosing, longitudinal waved markings, give the animal almost a black appearance. The tentacula are moderately long, conical, pointed, very tumid at their bases, black above, white beneath, on which the eyes, a little raised, are set externally. The foot is a very singular organ, short, rounded before and behind, scarcely auricled, and when in action forming an oblong suboval disk, divided by a central sunken line into two longitudinal lobes, which, when the animal marches, are each advanced *alternately* with an undulating vermicular motion. This curious longitudinally-divided foot and peculiar locomotion are only to be found in one or two other genera; they are particularly conspicuous in the *Phasianella pullus*. The under part of the foot is yellowish-white, bordered by a deep line at a little distance within the margin, from which fine transverse ones radiate, giving the foot the appearance of being encompassed by a fine fringe; the upper posterior part carries a dark, corneous, suboval operculum, with about two turns of elliptical striæ, and a very excentric

nucleus. The buccal apparatus is a deep-red fleshy mass, supported by two thin coriaceous plates, between which, in ordinary-sized animals, a long (at least 2 inches) riband-like white spiny tongue issues, passing down the œsophagus, and becoming closely coiled in the stomach; its termination is tinged with red. Immediately behind the buccal mass is the œsophageal cordon, which consists of only two white, subrotund, flattish ganglions, one on each side; and behind them are the salivary glands, each formed of a mass of foliaceous granules. There is only one branchial plume, of light yellow, attached to the left side of the mantle and neck of the animal. The verge is a large flat organ, grooved longitudinally, ridged transversely, dentated on one side with two points, one below the other, the lower one with a minute orifice: the female is oviparous. The antepenultimate whorls are always flat in this species, being a condition resulting from the shape and size of the ovarium, which is only adapted for *ova*; it is, however, much more prolific than the *Littorina rudis* and varieties.

This is the common edible periwinkle of the London markets, and the only one, as the females of the *L. rudis* and all its varieties are viviparous, and cannot be used for food in consequence of the grittiness arising from craunching the testaceous pulli; it is found in all situations, often exposed to the full influences of an open sea, but more usually in estuaries and muddy inlets, which are also the habitats of certain varieties of the *L. rudis*; it grows to $1\frac{1}{2}$ inch in length and 1 inch in diameter.

The pectinations of the branchial plume of nearly all the *Littorinæ*, instead of being 16–20, vary from 45–60; they are pale brown, long, slender, and close-set; an examination under the microscope sanctions this correction. Having repeated a series of fresh observations on some hundreds of the *Littorina rudis* in comparison with the *L. tenebrosa* and *L. jugosa* of authors, I am authorized to say, that the identity in figure and action of their internal and external organs has further satisfied me of the propriety of regarding them as varieties of the *L. rudis*; the only differences are colour and

size, resulting from the various complicated incidents attached to *habitat*.

I omitted to observe that the *Littorinæ* are destitute of head- and neck-lappets, and that the operculigerous lobe is small, simple, and not co-extensive with its organ.

L. RUDIS, Donovan.

L. rudis, Brit. Moll. iii. p. 32, pl. 83. f. 1, 2, 3, 5, 6, 7, & pl. 86. f. 1.
L. patula, Jeffreys, Brit. Moll. iii. p. 36, pl. 85. f. 6–10; (animal) pl. G.G. f. 2.
L. tenebrosa, Mont., Brit. Moll. iii. p. 39, pl. 84. f. 11, 12, & pl. 85. f. 1–5.
L. saxatilis, Johnston, Brit. Moll. iii. p. 43, pl. 86. f. 4, 5.
L. fabalis, Turton, Brit. Moll. iii. p. 49, pl. 86. f. 2, 3.
L. palliata, Say, Brit. Moll. iii. p. 51, pl. 84. f. 8, 9, 10.
L. zonaria, *L. rudissima*, *L. jugosa*, *L. neglecta*, Auct.

This well-marked species has nearly the same organs as *L. littorea*; I have compared the nervous ganglions and other internal parts of both forms, without finding distinction. To enumerate the greater part of the other organs, in comparison with those of *L. littorea*, would be a repetition; I will only mention the essential specific distinction, which is, that in the females of this species the large bulky ovarium is usually filled with strings of testaceous pulli, that is, if examined at the season when, O! Alma Venus, they are "perculsæ corda tuâ vi," the ovaries fill up the tumid antepenultimate volutions. The markings and colours of the animal have the same character as those of *Littorina littorea*, except that they are much less intense; but though closely allied, it is particularly distinguished by the much higher littoral level of its habitat, the greater tumidity of the volutions, by the colour, and, above all, by the very different ovarium, its contents and mode of reproduction. It rarely exceeds an inch in length, and $\frac{3}{4}$ of an inch in diameter.

To describe the varieties enumerated above, which are the pseudo-species of authors, would be to say, that the organs of all, both internal and external, do not vary in the slightest degree in form; the only differences are modifications of colour, size, and in the striæ, depending entirely on habitat.

The *L. rudis, L. tenebrosa, L. zonaria* and *L. rudissima* are usually inhabitants of the estuaries and muddy oozes, and rarely exposed to the full action of an open sea.

We earnestly recommend naturalists, in their respective localities, to consign the four species above-named to basins of water, together with all the dwarf varieties inhabiting the crevices of rocks, when they will at once perceive that they are all identical with the type *L. rudis*; it will afford a practical proof that species founded on the characters of the shells are artificial and delusive, and that the soft parts must also be considered to obtain specific distinction.

The *L. rudis*, and all the varieties, are extremely impatient of continued immersion in water; when deposited in basins, the first object is to escape therefrom, and attach themselves to a dry spot. In estuaries, where they are often affused by the fresh water, they become, particularly the *L. tenebrosa*, thin and depauperated in their shells; they are sometimes for weeks deprived of even being sprinkled by sea-water. Though decided Pectinibranchiata, they live in the open air with nearly equal facility as the Pulmonifera; and in reference to this fact, as regards another family, the *Conovulidæ*, there are still malacologists, who, notwithstanding the valuable observations of the Rev. T. Lowe and M. J. Berkeley, are not quite satisfied that they are pulmoniferous; we have ourselves attempted to corroborate these views, in our remarks on the *Pyramidellidæ*.

The *L. littorea* is the only species of this particular form that requires, to attain full growth, a regular bi-hodiernal immersion in sea-water, and to obtain it, the bulk of that species live in the lower littoral levels; if they are deprived of it, they become stunted and dwarf.

That variety of the *L. rudis* which is undoubtedly the *L. jugosa* of Montagu, varies from quite smooth to highly striated, and has even, ridged, reflected, spiral volutions, as represented in the figure of Montagu's 'Testacea Britannica;' it clothes the interstices of rocks on the Devon coasts in myriads. They are rarely or never immersed, as they dwell in the highest levels, in most exposed situations; in like manner

as the typical *L. rudis* and its variety *L. tenebrosa* inhabit the highest levels of the sheltered and protected estuaries. They are the parents of all the dwarf varieties, the *L. patula*, *L. subsaxatilis*, *L. neglecta* and *L. fabalis*, &c.

As a proof that habitat is the cause of these dwarf varieties of the *L. rudis*, I mention that the *L. littorea*, in company with them, at a few yards' lower level, are small, stunted, and nearly as dwarfish. By the favour of Mr. Bean of Scarborough, I have compared his *L. zonaria*, *L. rudissima*, *L. neglecta*, and *L. fabalis* with Devon specimens, and found them identical; consequently I presume the animals are so likewise.

These so-called species are viviparous. How happens this singular coincidence? how is it that none of them follow the plan of the reproduction of the other species? This is a very significant fact, and is, I think, a strong circumstance, in conjunction with the positive similarity of the animals, in favour of my position, that the spurious species belong to *L. rudis*, and of course follow the habitudes implanted by nature in the parent. It may be asked, does not the very important fact of the viviparous reproduction of *L. rudis* and its varieties indicate something more than specific distinction? I partook of this opinion, but on consulting a naturalist of the highest authority, he informed me, that in the lower classes, the fact of an animal being viviparous, without other circumstances, when its congener was ovo-viviparous, did not constitute sufficient grounds for generic distinction. The question is open, and I leave the solution of this problem to those who are better versed than myself in the mysterious laws of nature which relate to the genesis of the Mollusca.

I could adduce many more examples, of various values, of the sad confusion that has crept into and disfigured this highly interesting department of natural history, from the introduction of phantoms into our records, instead of soundly settled species. I refrain, and rest for the present on the great examples I have adduced in illustration of these observations, on the principle that "omne majus in se minus continet." If the preceding remarks have the effect of causing

greater circumspection in future in the creation of species, the object I have had in view will be accomplished.

L. NERITOIDES, Linnæus.

L. neritoides, Brit. Moll. iii. p. 26, pl. 84. f. 1, 2.
Turbo petræus, Montagu et aliorum.

Animal spiral; mantle even with the shell. The head is a long proboscidiform cloven muzzle, the upper part of an intense black cloud-colour; orifice of the mouth white, with a vertical fissure; tentacula awl-shaped, moderately long, flattened; eyes large, not on pedicles, but placed on the substance of the skin at the bases of the tentacula, inclining externally only in a trifling degree. The buccal mass is plain brown, supported by two thin coriaceous plates of the same colour, from whence a very long white spiny tongue proceeds to the stomach, and there lies coiled as in *Littorina littorea*; but it is proportionately longer than in that species, being 2 inches long. Foot nearly as in *L. littorea*, very slightly auricled and curved in front, rounded posteriorly to a terminus, which is a little jagged or dentated, forming an oval when not in action, but on the march a very elongated oval; above, its colour is black; underneath, a pale lead ground, mixed with two shades of white and one of purple. These colours are divided into three portions; the anterior one is the narrowest, of an intense hyaline-white; the middle is also hyaline, and the third is hyaline pale purple. The foot is not strictly divided into two longitudinal half-parts as in *L. littorea*, but at the anterior part, where the intense hyaline-white terminates, appears transversely broken or furrowed, so as to allow of a subdued alternate undulatory gait, or quality of progression, something like that of *L. littorea*, in which the whole of the longitudinal half is first advanced, and then the other; but here only half of the anterior part of the foot is moved forward, and then the other.

This alternate action of parts of the foot is a very singular character, which obtains, more or less, in all the true *Littorinæ*, and is with very few exceptions confined to the genus. There is only one branchial plume, and the internal and external

organs are nearly those of *L. littorea*. The sexes are distinct in all the Pectinibranchiata*. I ought to have mentioned the suboval corneous dark operculum, pointed superiorly with about two rapidly increasing gyrations, the nucleus being at the basal end.

This species is one of those that inhabit the highest levels of the littoral zone, and often dwells for an indefinite time far beyond even the spray of the sea. It appears a mystery how the branchiæ are kept moist: I suspect the minute saline particles carried by the winds suffice, especially as the long exposure to atmospheric influences has almost rendered the branchiæ of pulmoniferous quality. They clothe the rocks in myriads on the South Devon coasts. I sum up, and conclude the present species to be a true *Littorina*.

I mentioned above, that I was preparing further observations on that branch of the Littorinidan family which is termed *Lacuna*, and that I had reserved the description of the *Littorina littoralis* as a standard of comparison with its animals: I also stated my opinion, that they ought to merge in *Littorina* as species. I now present notes thereon, which I beg may be considered the sequence and termination of my former observations, and which, with the addenda, will render them nearly complete. These notes are the result of an examination and comparison of many living examples of the *Littorina littoralis* and the *Lacuna pallidula* of authors, which latter species, with me, will now be the type of a section of the *Littorinæ*, as I am confirmed in my views that the genus *Lacuna* is superfluous, and its species ought to pass to *Littorina*. My remarks embrace the *Littorina vincta*, "*puteolus*" and "*crassior*," which, with the *L. pallidula*, include all the varieties of the *Lacunæ* of authors. I am inclined to think I have named more species than really exist, and that they may be reduced to three, the "*crassior*" being considered, when denuded of the epidermal laminæ, a strong, elongated, smooth,

* Since this was written I have found reason to doubt this conclusion, as will appear hereafter.

plain, light brown, subcarinated variety of that form of the *L. vincta* termed "*quadrifasciata,*" which I have seen with the same oblique epidermal laminæ; but as the animal of the "*crassior*" has not been observed, this view cannot be received as certain. Though I have only examined the *L. pallidula,* I have little doubt that in all essentials the other species called *Lacunæ* agree with this type of a section of the *Littorinæ,* making allowance for the variation of species. I have given copious notes of the *L. littoralis* in comparison with the *Littorina pallidula,* mihi, and leave it to malacologists to draw their own conclusions, reserving to myself, as a finale, a short comparative summary.

L. LITTORALIS, Linn. et nobis.

L. littoralis, Brit. Moll. iii. p. 45, pl. 84. f. 3–7.

Animal spiral; mantle pale yellow, fleshy, but even with the margin of the aperture. The head is a cylindrical wrinkled muzzle capable of considerable extension, usually pale red on the neck, but the colours are very variable in this species, being yellow, orange, red-brown, and occasionally all the hues of lead-colour to nearly black. The under part of the foot is always white, or yellow-white. The buccal disk is pale yellow, subcircular, with a vertical fissure, within which the white riband-like spiny tongue is seen at its alternate opening and closing; it is when extracted nearly an inch long, and the anterior folded jaws are supported by the usual corneous plates and buccal apparatus. The tentacula are pale yellow-brown, each having two fine longitudinal lead-coloured lines running laterally from base to point, long, setose, conically tapering to not a very fine point; eyes small, on short offsets at the external bases. Foot at rest subcircular, in action an elongated oval, well rounded in front and behind, constricted moderately at the anterior third of its length, the other two-thirds margined with light drab opake transverse flakes, posteriorly puckered or jagged, with a central longitudinal depressed line. The anterior part of the pedal disk forms a terminal arcuated channel, which gives that part of the foot

the aspect of having a narrow upper lobe separated from the pedal disk, forming a pair of narrow labia; the upper posterior portion of the operculigerous membrane in this species is very slightly expanded laterally, and though not emarginate with caudal appendages, as in *Littorina pallidula*, is often sinuated and sometimes finely cloven. The operculum is nearly the shape of a vertical section of a pear, brown horn-colour; nucleus sublateral, leaning on the columella, with about 2½ gyrations, the last of which rapidly coalesces with the outer margin of the plate. The animal has the true alternate undulatory longitudinal characteristic progression of the *Littorinæ*. The neck is simple, without lobes. The branchial plume is single, on the left side, with 35–40 or more very fine long close-set pectinations, many of which in certain positions of the animal may be seen under the mantle without dissection. The orifice of the anus and the canal of the sac of viscosity are seen on the right side; in the female the matrix and its orifice, with the anterior part of the ovary, and in the male, the verge. The fæcal pellets are pale red and exactly oviform: I allude to this point, as I have sometimes found it a good distinctive aid.

I have mentioned rather more than can be seen without dissection; and I will only enter so far on the anatomy of this species as to observe, that I have carefully compared numerous specimens of the *L. littorea*, *L. pallidula* and *L. littoralis*, and I can pronounce all the internal organs, including the œsophageal ganglia, to be absolutely identical, allowing for the modifications of colour in the different species. The male *organe générateur* supplies the position of the matrix in the female, and the testis that of the ovary; the former springs under the right tentaculum, and is composed of two portions, the basal one being a tumid, annulated or rigid figure, dentated exteriorly, with the minute orifice at the external angle; the other angle is produced into a yellow, conical, arcuated, pointed, rather long process, the only use of which would appear to be that of an *organe excitateur*.

L. PALLIDULA, nobis.

Lacuna pallidula, Brit. Moll. iii. p. 56, pl. 72. f. 1, 2, and f. 3, 4 (as *patula*).
Nerita pallidula, Da Costa.

Animal spiral, nearly white throughout; mantle simple, tumid at the margin, but even with the aperture of the shell. The head is a cylindrical produced annulated muzzle; the upper part of the neck has two short flake-white diverging lines imbedded in the ground colour; the disk is transversely oval with a vertical fissure, within which the white spiny tongue can be seen in action. The tentacula are long, setose, and taper conically to their termini, with rather small eyes raised on short external offsets. The foot is always white below, pale drab or yellowish-white, or white, above, of oval shape in quietude, when on the march oval-elongated, rounded anteally and posteally, with occasionally slight emarginations behind, very considerably contracted at the anterior third of its length, with a pale flaky border; the other two-thirds have an intense flake-white margin. There is the central longitudinal fissure or groove that gives the animal the undulatory quality of progression, by alternate halves of the foot, which action is the principal generic characteristic of the true *Littorinæ*. The thin upper membrane that bears the operculum extends nearly to the junction of the foot with the body; the anterior terminus of the foot is slightly grooved, forming a sort of upper and under lobe, or pair of shallow labia; the operculigerous lobe, is expanded laterally beyond the pedal limits into minute wing-like processes, and at the terminal point is subcircularly scalloped out; the lateral margins forming usually two, sometimes three or four very short, white, caudal fillets of different lengths, variously shaped, but usually compressed and slightly triangular; these are occasionally in the same species either rudimentary or quite obsolete. The single light brown respiratory plume can, in certain positions of the animal, be observed, branching from left to right; it has 35–45, or more, long, slender pectinations; there may also be seen, without dissection, the short white termination of the rectum, accompanied by the excretory

canal of the sac that contains the viscous fluid. The neck of the animal is simple and free from membranous lappets, as is the case in all the *Littorinæ*. The fæcal pellets are elongated, slender, subcylindrical, having the apices tipped with a dark hue. The verge is a long, simple, arcuated, flattish, pale yellow process, regularly tapering from its insertion under the right tentaculum to a fine point. The operculum is pale horn-colour, subelliptic; nucleus excentric, sublateral, abutting on the columella, with $2\frac{1}{2}$ volutions, the last of which rapidly unites with the margin. We repeat the remark on the internal organs of the *Littorina littoralis*, in comparison with this species, that they are identical.

Malacologists will observe, that in the two species the internal and external organs are *essentially* the same; the only variations are, that in *Littorina pallidula*, the caudal filaments, the expansions of the operculigerous lobe, and the form of the *organe générateur*, are not precisely similar to the parts in *L. littoralis*. The former are very variable specialties and cannot be depended on: *ex. gr.* the *Lacuna puteolus* of authors is without caudal processes, or at least they are obsolete; the same observation may be made of the *Rissoæ*, no two animals of the same species being similar in respect of caudal accessories, and many are without them. The male organs of the two undoubtedly vary in structure; the groove or lacuna in the pillar, from whence the generic title, is a mere modification of the umbilicus, which, from its variableness, is not of specific value, and is quite misapplied to generic determination. All the variations we have mentioned are specialties of slight consideration, which cannot be put in competition with the essential generic characters of the foot, and its singular plan of locomotion, which stamp the so-called *Lacunæ* of authors as genuine members of the genus *Littorina*.

Since the above was written, I have reviewed, in a living state, all the *Lacunæ* of authors, except the "*crassior*," and I think I am authorized to be still more "tenax propositi," that they are a section of the genus *Littorina*, and cannot be severed from it without violence to true generic value. I find

them all with variable excrescences of the operculigerous lobe of the foot. The *Lacuna puteolus*, which is a distinct species, has the lateral appendages large, but the caudal filaments very short, and often obsolete: the *L. pallidula* has the lateral wing-like extensions, with 2–4 very short caudal fillets: the "*quadrifasciata*," a variety of the "*vincta*," besides the accessories of the "*pallidula*," has a very short style at the central posterior point of the pedal disc: the "*crassior*" I have mentioned above. The *Lacuna fasciata* of authors is referable to the *L. vincta*, and not to the *L. puteolus*. I may state that the caudal and operculigerous accessories are not only variable in the species, but the individuals of each are also subject to variations in these parts.

It appears very doubtful if these alated lateral extensions and caudal filaments are of much generic value, from their variableness in many species, and almost total absence in others; I think that they may be considered as analogous to the variation of certain organs in other animals. We may observe, that the caudal appendages of the dog, even when unmutilated, are very variable: contrast the greyhound with the setter, terrier, bull or shepherd's dog. But surely no one will contend that the variations in these points, either in the mollusk or the dog, have generic value. If any of these animals were without caudal terminations and operculigerous lobes, that circumstance might contribute to establish generic value. The points of support, then, for the establishment of the genus *Lacuna*, rest on the lateral and caudal variations of the operculigerous lobes of the foot, some difference in the *organe générateur*, and in the lacuna or groove in the columella of the shell, which is merely an incomplete umbilicus that is very conspicuous in some species, in others almost closed up; and often in the same species, the *Puteoli*, it is sometimes apparent, and frequently scarcely visible: in all other respects these *Lacunæ* are similar to the *Littorinæ*. In opposition to these pretensions, I repeat, that all the so-called *Lacunæ* have invariably the form of the pedal disc of the *Littorinæ*, accompanied by the overwhelming characteristic vermicular alternate quality of progression which is almost

exclusively confined to that genus, and which must, I think, fix the *Lacunæ* of authors for ever as one of its sections.

With regard to the aid derived from the tongues of the Gasteropoda for generic or specific distinction, I am inclined to think its importance overrated, because no two species of the same genus have a precisely similar disposition of the rachis, uncini, and arrangement of the spines and interweavings of the lingual riband. This fact sets at rest generic views; the tongues, at best, are of mere specific value. I have examined hundreds, and can make nothing of them that can at all be depended on, from their extremely variable structures. The tongues of great numbers of the minor species cannot without extreme difficulty be obtained by the scalpel; they can only be detected after maceration, and compression under a powerful microscope, and the comparison of these minute species is attended with difficulties and very unsatisfactory results. The ootheca of the Mollusca may be useful in comparison, if they can be obtained, and identified to belong to certain species.

I conclude, and insist on the foregoing positions, with as much tenacity as courtesy will allow to the phrase. I cannot even consent that the *Lacunæ* be considered a subgenus of the *Littorinæ*. I think the term *subgenus* an unsatisfactory and hybrid expedient to attempt to express an intermediate state that does not exist; with me, subgenera are resolved either into distinct species or genera. If I might consider that those who use the term subgenus mean to define it as an aggregation of particular or aberrant species of a distinct genus, I would accept the definition, but not the term, which ought to be *section*, as that of subgenus seems to imply something beyond divisional arrangement.

The *Littorina puteolus* with us, and its congener *L. vincta*, though examined, are not described. The *Littorina crassior* we have not seen.

LITTORINA PUTEOLUS, nobis.

Lacuna puteolus, Turton.

————————, Brit. Moll. iii. p. 58, pl. 72. f. 7, 8, 9; pl. 74. f. 9.

LITTORINA VINCTA, Montagu.

L. vincta, Brit. Moll. iii. p. 62, pl. 72. f. 10, 11, 12; pl. 74. f. 7, 8; pl. 86. f. 6, 7, 8; (animal) pl. G.G. f. 4.

LITTORINA CRASSIOR, Montagu et nobis.

Lacuna crassior, Brit. Moll. iii. p. 67, pl. 72. f. 5, 6.

RISSOA, Freminville.

R. ULVÆ, Pennant.

R. ulvæ, Brit. Moll. iii. p. 141, pl. 81. f. 4, 5, 8, 9; pl. 87. f. 2, 8; (animal) pl. J.J. f. 8.

R. subumbilicata ?, Montagu.

————————, Brit. Moll. iii. p. 137.

Animal spiral, of 6–8 volutions; mantle plain; head a long dark proboscidiform muzzle, emarginate in the centre in front, marked with two transverse bars, and its margins edged with the same dark colour; buccal disk pale brown or yellow, with a vertical fissure, from which, when the animal gapes, a pair of curved jaws are seen; these are the anteal termination of the lingual riband, which makes its way to the stomach through a pair of fleshy, or rather horny, plates, the whole forming what is called the masticatory apparatus; tentacula very long, cylindrical, slender, pointed, very little setose, whitish-yellow, with a black bar at a short distance from their termini; eyes at the external bases on short protuberances; foot short, truncate and auricled in front, rounded, and, in some individuals, slightly emarginate posteriorly. In the lighter coloured variety, the upper part is a pale brown, beneath yellowish-white, with a border of minute pale golden flakes, with sometimes a dark bar running through the centre of its posterior part; in the darker variety, the upper part of the foot is clouded with very fine dark lead-colour to its paler hues, underneath pale brown.

These animals creep with great rapidity, and float with the foot uppermost by means of an hydrostatic apparatus, as air-bubbles are seen continually to proceed from the aperture; they are strictly littoral, and inhabit in myriads the green oozes of the estuaries.

I have no hesitation in consigning this species to the genus *Rissoa*. It differs in many points from the true *Littorinæ*, especially in having the foot short, truncate, auricled in front, and rounding to an obtuse point behind; the under surface is not subdivided as in *L. littorea*. It has not the entire aspect of the foot of the *Rissoæ*, being without the posterior filamentary appendage of the operculigerous lobe of the type; and in its progression has not a trace of the oscillatory action so conspicuous in the foot of the typical *Littorinæ*, which I believe never swim; the *Rissoæ* in general are oftener seen floating in a reversed position than otherwise.

The shells of this section of the *Rissoæ* are subject to great variety from locality, varying in the number and in the inflation of the volutions, and in colour from pale brown or yellowish-white to dark red-brown or horn-colour. I think that one of the light varieties with the tumid volutions is Montagu's *Turbo subumbilicatus*, which species appears to be in great obscurity. Having carefully examined the animals of all the varieties, I can decidedly state that they are identical with the typical *Rissoa ulvæ*. I am much inclined to think that the *Rissoa Barleei* is one of the varieties.

Having repeated the examination of two of the varieties of the *R. ulvæ* found at Exmouth, the one having a pale horn-coloured shell with flat volutions, the other tumid and red-brown, with the animal rather larger and of a darker lead-colour than the former, I am enabled to state, that I cannot discover the slightest organic difference between the two, and their action and habitudes are identical. The variation arises from habitat; the one, the pale variety, is found lurking under stones, the other exposed in the open patches of the green oozes of the estuary. The shells are so different in aspect, that the conchologist would pronounce them distinct, but the malacologist steps in, and offers a practical example of the superiority of his determinations, by showing the two to be identical. Both the varieties have the under part of the foot aspersed with sulphur-yellow, opake, minute flakes. The operculigerous lobe is ample, and extends a little on each side, beyond the pedal disk, or forms what, by some, are called minute wings; these

are very dark; it carries a light, corneous, suboval, paucispiral operculum, with fine oblique striæ. The foot is perfectly rounded behind, and in almost all specimens more or less emarginate, though in some scarcely visible, in others decidedly so, at several points of the arcuation; it is truncate and well auricled in front, without a medial line. There is invariably a very short cylindrical process or fillet exserted from that part of the mantle which lines the anal canal or upper angle of the aperture: I am unable to say anything as to its use: whether such an appendage exists in other minute congeneric species, and from its minuteness has passed without observation, must be left for future examination. I consider this species a *Rissoa*. Though it has not the caudal filament and pointed pedal termination of the typical *Rissoæ*, we must not forget that there are some *Rissoæ* with rounded tails and without a caudal cirrhus at the termination of the operculigerous lobe.

I have elsewhere said, that every British *Rissoa* must have a distinct genus, if we insist on a literal agreement with the type *R. parva*; they all differ as much, or even more, from it, than the *R. ulvæ*; indeed, this species only varies in the broader foot, its rounded posterior termination, and in being without a cirrhus. Some authors deposit the *R. ulvæ*, with one or two more species of the estuaries, in Pfeiffer's *Paludinella*: surely this is sad generic refinement. Since the observation above, on the filament springing from that part of the mantle which lines the upper angle of the aperture, I can report, that it is present in almost all the *Rissoæ*, but its precise use is not yet satisfactorily made out.

R. PARVA, Da Costa.

R. parva, Brit. Moll. iii. p. 98, pl. 76. f. 2, 6; pl. 77. f. 6, 7; pl. 82. f. 1–4.
R. interrupta, Brit. Moll. iii. p. 100; et Auct.
R. costulata, Alder.
————, Brit. Moll. iii. p. 103, pl. 77. f. 4, 5.
R. rufilabris, Alder.
————, Brit. Moll. iii. p. 106, pl. 77. f. 8, 9.

R. labiosa, Montagu.
———, Brit. Moll. iii. p. 109, pl. 76. f. 5; pl. 77. f. 1, 2, 3; pl. 81. f. 3.
R. Sarsii, Brit. Moll. iii. p. 101.
R. discrepans, Brown, Brit. Moll. iii. p. 101.

Animal spiral; mantle plain, just even with the shell. The head is a short dark brown muzzle, cloven with a vertical orifice beneath, the disk of which is yellow; tentacula long, slender and cylindrical, yellow, with a longitudinal row of white detached flakes, and often the reverse, white with yellow interrupted flakes; eyes on short offsets at the external bases. Foot flaky-white above and beneath, long, narrow, truncate in front, slightly auricled; the point is blunt, from whence a small upper lobe or alated membrane springs, on which is fixed a suboval corneous operculum with spiral loose striæ, and at its extremity a single short white tentacular filament is seen. The branchial plume consists of 15–18 minute vessels attached under and to the mantle and back of the neck.

This is one of the forms that conchologists have taken possession of for the manufacture of varieties into species. The type *Rissoa parva* is a most variable species, resulting from locality and other causes. The animals of all the varieties enumerated above are identical. We have examined them all, and can find no appreciable difference except varieties of colour and occasional variations in the length of the terminal filament, which is never in any two selected shells precisely similar. The *R. costulata* is an elongated variety; the *R. rufilabris* a short tumid one, with a red or pink peristome, which may often be seen in its congeners. The *R. interrupta* is a more slender, thin, less plicated, dwarf variety. And lastly, the typical *Rissoa parva* varies so much that it is difficult to find two shells alike. These varieties live in company in the lower levels of the littoral zone, but are more plentiful at the borders of the laminarian district.

The *R. labiosa* is an aberrant form of this species. It has, like the type, a smooth variety, and the gradations between the type and synonyms can be well traced. The *R. Sarsii* and

R. discrepans, Brown, mentioned in the 'British Mollusca,' vol. iii. p. 101, the first figured pl. 82. f. 3, and the latter, pl. 76. f. 2. are mere varieties of this most polymorphous species.

We take this opportunity to remark, that there are a number of minute apocryphal objects, termed *Turbo* and *Helix*, &c., recorded by Montagu, Turton, Adams, Walker, and Brown, which, from the wretched figures and meagre descriptions, defy definition and identification. They are probably the pulli of other species, and may with equal propriety be consigned to ten as to one parent. They are only alluded to in the 'British Mollusca,' for future possible reference; it would be lost labour to notice them farther, and we trust that the time is passed for the infliction of such descriptions and delineations of objects of natural history.

R. FULGIDA, Adams.

R. fulgida, Brit. Moll. iii. p. 128, pl. 81. f. 1, 2, and p. 169.

Animal inhabiting the most minute of the British rissoidean shells, of four tumid volutions, marked on the basal and antepenultimate ones with two dull red-brown and two light yellow bands, arranged alternately. Aperture nearly orbicular; outer edge thin, without a callous pad, and with a subperforated columella; axis $\frac{1}{25}$th, diameter $\frac{1}{35}$th of an inch. Mantle yellow, even with the aperture, and without the pendant filament at the upper angle. Rostrum short, not corrugated, flat at the extremity, vertically cloven above and below; disk pale yellow, with a fine dirty-brown line marking the fissure. The usual buccal apparatus can be seen in action. Tentacula moderately long, strong, divergent, rounded at the ends, and under high powers slightly setose; they are not much vibrated on the march, of a pale yellowish-white hue; eyes large, at their external bases, on slight protruding inflations. Foot not very short, nor proportionately so narrow as in the typical *Rissoæ*; rounded in front, slightly labiated, and constricted anteally, but not auricled; also rounded behind, having a medial longitudinal line on the posterior half; colour above yellowish-white; below, confused flake-

white. Operculigerous lobe small; the alæ anteriorly are mere lines, but exposed posteally in flat limited curves, carrying far behind a suborbicular, pale yellowish-white, very indistinct, paucispiral operculum, obliquely finely interstriated, with a sunken nucleus: no caudal cirrhus: the edge of the operculum is marked with a fine brown line.

The animal is free, but the progression is not direct; it often jerks or screws the shell a quarter of a round, and carries it almost perpendicularly; it is abundant in the middle littoral levels near Exmouth.

Though this species differs in many points from the typical *Rissoæ*, still there is nothing so essentially different as to require a new genus; and I am of opinion that the newly constituted genera *Paludinella* and *Hydrobia* are unnecessary, and not generically separated from *Rissoa*.

R. INCONSPICUA, Alder.

R. inconspicua, Brit. Moll. iii. p. 113, pl. 76. f. 7, 8, and pl. 82. f. 5–9.
R. pulcherrima, Brit. Moll. iii. p. 129, pl. 85. f. 1, 2.
Turbo albulus ? Adams, Linn. Trans. iii. pl. 13. f. 17, 18.

Shell ovately conic, pointed, with 6–7 moderately-raised volutions, very pale yellowish-white, marked with two rows of longitudinal, distantly separated, dull yellow or rufous irregular linear blotches on the body, and one on the antepenultimate whorl. The sculpture is very variable, sometimes almost smooth, at others with close-set, longitudinal costellæ, showing all the phases of strong and fine lines, crossed at right angles by finer ones. There are one or two grooved circular lines at the base of the body volution. The aperture is suborbicular, and the outer lip has the callous pad of the *Rissoæ*. Axis $\frac{1}{10}$th, diameter $\frac{1}{18}$th of an inch.

Animal. Ground colour white, blotched with yellow and dark smoke hues. Mantle entire, except that at the upper angle of the aperture it has the pendant filament so often seen in the *Rissoæ*, and the use of which still remains doubtful. Rostrum short, cloven, carrying the buccal disk beneath, with its vertical fissure, and the usual masticatory apparatus of a pair of jaws, corneous palate, and tongue; it is tinged

with muddy yellow or orange above, but brighter on the under surface. The tentacula are very long, white, and slender, clothed with distinct horizontal setæ from base to point, which become more rare towards their termination. Eyes black, on minute yellow prominences at the external angles. Foot very long and narrow; the front portion is greatly extended on the march, subrotund, slightly labiated and scarcely auricled, terminating posteally in a lanceolate point; the centre of the sole has a depression, accompanied by a posterior medial line; on each side the upper surface, about the middle, is a well-marked line of lead-colour. The operculigerous lobe is very distinct, though not much alated anteally, and terminates in an expansive rounded membrane, which, like the foot, is marked on each side with a blotch of dark lead-colour, but of greater width; these run into and almost unite on the upper surface, forming what some authors term a posterior dark spot. At the anterior junction of the foot with the body there is a transverse yellow or orange band, which is seen through the sole; the operculigerous lobe emits a very long and distinct caudal cirrhus, as much so as in *R. parva*, and it carries close to the posterior part of the foot-pedicle, a suboval, white, obliquely striated, paucispiral, corneous operculum.

The animal in every respect represents a typical *Rissoa*; it is remarkably lively and free, and affords every facility for examination. It marches with great rapidity, and inhabits abundantly the coral zones of the South Devon coast at Exmouth, in an offing of six miles.

I have stated in the 'Annals of Natural History,' vol. vi. p. 33. N. S., that I thought this species a coralline zone variety of *R. parva*; I withdraw that opinion, as I am satisfied of its distinctness.

The preceding observations were written in 1851, but in the summer of 1852 I had the good fortune to meet with some rare unrecorded animals of the British *Rissoæ*. To show that an account of these minute species is a desidera-

tum, I need only quote the learned authors of the 'British Mollusca,' who, speaking of the *Rissoa striatula*, remark, "The animal of this, as of too many other *Rissoæ*, is yet unknown."

I have reviewed, at Exmouth, the several species already alluded to, and added some new ones; I may therefore speak with increased confidence of their descriptive accuracy as far as regards the external organs, but I apprehend that a correct anatomy of such minute creatures is a vain expectation; we must therefore rely on analogy, for at least the general characters of their interior organization.

It is necessary to mention that the almost microscopic organs of these diminutive species require the aid of good glasses to see their true forms and attributes; the present descriptions are the result of the organs being viewed through Coddington lenses of as high powers as were consistent with distinctness: inferior means give false appearances, and are often the cause of discrepancies between observers of the same animal.

R. STRIATA, Montagu.

R. striata, Brit. Moll. iii. p. 94, pl. 78. f. 8, 9.

Animal inhabiting a white shell of 5–6 rather tumid, semiplicated, spirally striated volutions; it is hyaline-white in most parts; an exception is the upper and under surface of the rostrum and buccal fissure, which are of a sordid light red-brown. Mantle even with the shell, except that a minute cirrhal filament, very difficult to be seen, issues from it at the upper angle of the aperture, as in the type *R. parva*, in which it is never absent.

The head is a long flat muzzle, deeply grooved above and below, with minute lappets on the upper surface near its termination, and on the march is carried a little in advance of the foot. The tentacula are moderately long, divergent, strong, but flattened, very little setose; they do not attenuate to points like the type, but are of the same breadth throughout, and of opake snow-white; in progression they are extended considerably beyond the head. The eyes are conspicuously black, and placed on minute, scarcely projecting, external

offsets. The foot is truncate in front, grooved so as to form a labium, and slightly auricled; it is altogether stronger than in *R. parva*, and like it rarely extends to the limit of the body volution, and terminates posteriorly in a moderately-pointed lanceolate shape; there is a very slight trace of a longitudinal line in the centre of the sole. The operculigerous lobe has the margins laterally so lax and disunited as to form wings, which on the march, at the will of the animal, continually change their appearance; on it, near the junction of the foot with the body, is the light horny oval operculum of three spires, the first two minute and scarcely traceable; the last enlarges rapidly, and shows distinct striæ of growth. There is no caudal cirrhus on the opercular lobe, which is nearly coextensive with the main foot, and so pointed as to appear like one, and in some specimens is unequally emarginate at the sides.

The animal is not shy, and marches with vivacity; it has been remarked that it is disproportionately small for the shell, and the tentacula very short; I do not think our southern examples confirm this view: it inhabits all the districts. The records of this common species are so scanty, that it may almost be looked on as undescribed.

R. SEMISTRIATA, Montagu.

R. semistriata, Brit. Moll. iii. p. 117, pl. 80. f. 4, 7.

The animal occupies a shell of six moderately convex volutions, each partially striated, the middle portions being smooth. Its colour is nearly white, with the palest tinge of yellow. The mantle is even with the shell, except a short minute filament that is protruded by the animal from the portion which lines the upper angle of the aperture, like that I have mentioned in the *Rissoa parva* above, and in the *R. ulvæ*, in the 'Annals of Natural History,' N. S. vol. vi. p. 33. The head is a short muzzle, not so long as in the type, but similarly grooved in the centre above, and cloven at the extremity and below. The tentacula are flattish, rather long, divergent, frosted, pale yellow or white, with the tips slightly clavate; the eyes are on gently raised prominences at

the external bases. The foot is nearly the shape of the type, contracted in the middle, pointed behind, and sometimes emarginate, but it is proportionately longer, larger, and thicker; there is no groove or longitudinal line on the sole; the upper lobe anteally expands into narrow white wings, and terminates behind with three caudal processes, whereof the middle is the longest, and writing of it to Professor Forbes, I termed it a "bashaw with three tails"; it carries the light corneous suboval operculum at some distance from the end of the foot, but the first two turns of the spire are nearly obsolete; the third occupies the greater portion of the plate, and is well marked with oblique lines of growth.

I have lately examined many lively specimens, and can confirm the fact of the operculigerous lobe terminating in three filaments, as well as the presence of the short mantellar process, that is produced and retracted at the will of the animal, from the upper angle of the aperture. What are the functions of this organ is doubtful; it has not the aspect, nor the position, of a reproductive element; it has more the resemblance of a tentacular instrument; but in some *Rissoæ* it acquires an imperfect tubular appearance, as in the *Chemnitziæ*, in which, particularly *Ch. acuta*, it seems to perform the office of the branchial siphon of the Canalifera. I believe that this appendage has scarcely been noticed by authors; it appears to exist in many of the *Rissoæ*, but if in all is doubtful; it has no connection with the operculigerous lobe, or its wings or caudal cirrhi, but is a strictly mantellar process. The animal is free, unusually rapid on the march, inhabits all the zones, and has not been before observed.

R. COSTATA, Adams.

R. costata, Brit. Moll. iii. p. 92, pl. 78. f. 6, 7, and iv. p. 263.

Animal inhabiting an elaborately sculptured, costated, spirally striated, basally ridged, pale yellow shell, of 5–6 rounded volutions, hyaline-white, except the large black eyes and pale red buccal disk. Head a long proboscidiform muzzle, finely corrugated in quietude, cloven vertically at the orifice, as in *R. parva*, but showing more partially than in that species the

corneous jaws and buccal apparatus. The mantle is plain and even. The tentacula are long, flat, not filiform, rather thick at the base, tapering gradually to a rounded extremity; they are not setose: the large eyes are fixed on prominences at the external angles. The foot at rest is short, on the march it extends to the middle of the antepenultimate volution; it is labiated in front, but not auricled, constricted above instead of in the middle, as is more usual in *Rissoa*, and then expands and tapers to a narrowish attenuated rounded termination. The operculigerous lobe dilates into subcircular lateral wings, bearing close at the junction of the foot with the body, a suboval, corneous, faintly spiral operculum, with the turns rapidly increasing, as in the paucispiral *Littorinæ* and typical *Rissoæ*. It has a distinct caudal cirrhus.

Malacologists, from the curious sculpture and entire, flat, striated, broad margin of the peristome of the shell, have thought that this hitherto unrecorded animal would display singular features; but that is not the case; it is a very simple creature, and scarcely differs from the *R. parva*, except in having the tips of the tentacula rather flatter, more rounded, and in the different position of the constriction of the foot. The animal is active, marches up a glass with uncommon rapidity, and displays a freedom beyond the usual habits of the tribe. It is found in all the zones.

Some live examples of this species having recently occurred, I add to the above account, that the front part of the foot is marked with an intense snow-white flake of the figure of the letter V, visible in consequence of its transparency above and below. I have also to remark, that the anterior terminal line of the foot is unusually deeply incised, so as to form two labia; the lower, or that of the sole, at the centre part, on the march is produced much beyond the upper lip. I had never before seen this feature so extensively developed in any *Rissoa*.

And lastly, I may state, that I failed to detect satisfactorily the small pendant process in the mantle at the aperture, which is so conspicuous in *R. parva* and *R. semistriata*; yet it may exist: I had the same difficulty in *R. striata*, but I saw it afterwards in several examples.

R. RETICULATA, Montagu.

R. Beanii, nonnull. et Brit. Moll. iii. p. 84, pl. 79. f. 5, 6.
R. sculpta, nonnull. et Brit. Moll. iii. p. 88, pl. 80. f. 5, 6.

The animal occupies a spiral, cancellated, pale yellow or brown shell, of 5–6 tumid volutions; its ground colour is yellowish-white. Mantle even with the shell, except the filamentary process at the angle of the aperture. Head proboscidiform, furnished with the usual cloven disk and buccal appendages; the rostrum near its termination at the upper surface appears to have attached to it two very small similar shields, one on each side, independent of the terminal minute subcircular flat lobes. The tentacula are compressed, slender, rather long, rounded at the extremities, not setose: the eyes are at the external angles, on short light yellow or orange pedicles. Foot subrotund, scarcely auricled, but grooved in front sufficiently to form a shallow labium, slightly constricted anteriorly at one-third the length, gently tapering to a rather obtuse lanceolate but not emarginate termination. The operculum is carried on an upper, plain, moderately alated lobe, at nearly the point of the junction of the foot with the body; it is pyriform, with indistinct rapidly-increasing paucispiral gyrations; the terminal part of the lobe, like the *R. semistriata*, is furnished with three blunt, cylindrical, short cirrhi, and occasionally one of the sides of the main foot is emarginate. The branchial plume is composed of 12–15 single, pale yellow, short strands, which are visible when the neck is greatly exserted. The animal is active and freely shows its points. Common in the coralline zone, but rather rare alive.

This is the true *Turbo reticulatus* of Montagu; it is, however, subject to considerable variation of the contour and quality of the cancellations, which have led to the fabrication of some spurious species.

This species has not before been described. The specific appellation of '*reticulata*' must be substituted for '*Beanii*'; — a complimentary term ought not to take the place of the long-accredited and not doubtful one of the admirable Montagu.

R. PUNCTURA, Montagu.

R. punctura, Brit. Moll. iii. p. 89, pl. 80. f. 8, 9.

This species has been confounded with the preceding, but having met with many live specimens, it will be seen that Montagu has properly distinguished it. The animal is lively and freely shows its organs, and in this instance I have it in my power to effect a description by reference. It is in every respect identical with the *R. reticulata*, with the exception of a particular-seated and constant variation of colour; the operculigerous lobe is a very pale muddy reddish-brown, but it is marked on each side, close to the junction of the foot with the body, with an irregular, rather large, dark, smoke-coloured stripe, which is invariably wanting in *R. reticulata*.

Though differences of colour are not generally to be received as good specific characters, yet, when we see certain markings in an animal in a particular position, which are always absent in one that resembles it in almost every other point, we are entitled to consider them as fair specific differences; and in this case distinctness is corroborated by a considerable variation in the contour of the two shells, the *R. punctura* being much smaller, with more rounded and less tumid volutions, as well as having the sutures more deeply impressed than in the *R. reticulata*.

Since the above observations were made, I have taken many of this and the preceding species, and in the present animal have always found the dark lead-coloured marks on the operculigerous lobe, with the addition under the neck, near the eyes, of a small red dot; but these particulars are absent in the *R. reticulata*, the same parts being pure white. Both inhabit the coralline zone, and at Exmouth the *R. reticulata* is strictly confined to a coralline area, whilst the *R. punctura* occupies the interstitial grounds of that district, in muddy patches, mixed with comminuted shelly spoil. I cannot doubt the distinctness of the two.

R. SOLUTA ? Philippi.

R. soluta, Brit. Moll. iii. p. 131, pl. 75. f. 3, 4, and iv. p. 265.

The animal occupies a simple, elegant, minute, spirally

striated, almost microscopic, pale yellow shell, of 3–4 rounded volutions. The mantle does not extend beyond the aperture. The colour is hyaline-white, with a trifling exception. Head proboscidiform, having its terminal pale red disk vertically cloven, in which the buccal organs are distinctly visible. The tentacula are moderately long, rounded at the tips, very pilose, the setæ springing from them horizontally, but only visible with high powers; eyes at the external angles, on small, scarcely raised, pale sulphur-coloured eminences. Foot subtruncate, slightly auricled, labiated or grooved anteally, and long and narrow. Operculigerous lobe small, and not much alated; no caudal cirrhus was detected; the light corneous operculum is suboval and paucispiral, fixed nearly at the extremity of the foot. The animal is exceedingly vivacious and free, marching up a glass with singular rapidity. It is very abundant alive in the coralline zone, in 14 fathoms water, off Budleigh Salterton, Devon.

June 1853.

Additional remarks.— That part of the mantle which lines the upper angle of the aperture has the pendant linear filament so often alluded to in the *Rissoæ*. The operculigerous lobe anteally is not much alated, but posteally it expands in a rounded form. Many lively examples have shown that the caudal part of the upper lobe extends to nearly the end of the main foot, almost coalescing with it, and terminating in a single, short, but decided cirrhus; and lastly, the upper part of the rostrum is coloured pale dull red-brown; the under has on each side a patch of bright sulphur-yellow; the terminal flattish lobes of the rostrum divided by the fissure are rounded, with a very minute external rectangular shoulder to each. It appears that this species is a strict *Rissoa*, only the ends of the tentacula are more rounded than in the type, and furnished with fine horizontal hairs or setæ.

R. PROXIMA, Alder.

R. proxima, Brit. Moll. iii. p. 127, pl. 75. f. 7, 8, and iv. p. 264.

The animal inhabits a thin, sordid white shell of four

rounded, deeply separated, rather oblique volutions, which are, particularly the body one, closely, but superficially, spirally striated; the caducity of the striæ renders this species very liable to become glabrous from attrition. The general colour of the external organs is a brilliant subhyaline white, but, though aspersed with minute opake snow-flakes, the transparency is scarcely impaired. The mantle is even, and does not emit a process from the portion that lines the upper angle of the aperture. The head, when quiescent, is a short subcylindrical rostrum, quite smooth and rounded at the termination; it is not tunicated, lobed, grooved, nor vertically cloven on the upper part, and on the lower area it forms a disk, which has not a distinct vertical fissure as in *R. parva*, but shows a fine crosial incision, which is the alimentary orifice; and within it are probably the corneous jaws and buccal apparatus, but I could not detect them, perhaps from being of the hyaline colour of the rostrum, which is so pellucid as to allow the intenser white canal or œsophagus leading to the stomach to be seen through the walls.

When the animal is on the march it often suddenly evolves the rostrum to double its usual length, at the same time expanding the termination into a large disk or finely dentated flattened rose, which it throws back on the margin of the upper point of the aperture, and then as quickly withdraws the extension to its usual limits: whether this curious manœuvre is part of the animal œconomy, or of the nature of that which is sometimes seen in the typical *Rissoæ* when disturbed, I cannot determine until more specimens are observed; at present, I think the action peculiar to this species.

The tentacula are flat, strong, rather short, flake-white, smooth, gently attenuating and becoming minutely claviform at the tips, which are each clothed with six comparatively long, intensely aciculate setæ; the eyes are unusually large, black, and fixed on minute sub-semicircular lateral excrescences at the external bases, and are so amalgamated with them as scarcely to present a prominence. The foot is a curious organ, being large, fleshy, anteriorly grooved, so as to form a slight labium, deeply indented in the centre, and pro-

duced into large, long, arcuated, pointed auricles; posteally it becomes divided into two long, distinct tails or streamers, nearly coextensive with the shell in its axial admeasurement; close to the bifurcation is a small opercular lobe without a caudal cirrhus, on which is fixed a beautiful white horny sub-oval operculum of 4–5 spires; the first two or three are small and concentrated, the last suddenly enlarges and closes the aperture, and is marked with delicate oblique striæ of growth. The neck, when greatly protruded, is blotched at the sides and on the top with a claret-coloured red: these marks, and the eyes also, when not exserted, are conspicuous through the tenuity of the shell.

This rare animal, of which I have taken seven live examples, dwells in a muddy-bottomed shelly district of the coralline zone in Exmouth Bay, eight miles from shore, in 15 fathoms water.

This species has occasioned much difference of opinion; some naturalists have thought it distinct; others have considered it the Montaguan *R. vitrea* in a perfect condition, and looked on his shell as a specimen denuded of its striæ by attrition. They say that many of the so-called *R. vitrea* of the cabinets, when placed under the microscope, exhibit traces of the striæ of the '*proxima*': in this fact they are probably correct, because these smooth examples may really be that species; but they are wrong in their conclusions that it is Montagu's shell, as will appear by the discovery of a perfect specimen and lively animal of a species, which, I think, whatever doubts may still exist, must now be considered the "smooth shell" of that author, long known as the *Turbo vitreus*, and which has not the slightest traces of spiral striæ. The present difficulty has arisen from Montagu's description suiting a worn '*proxima*,' or the shell I propose to regard as the '*vitrea*.' If I had not made the present capture, I should, like others, have judged the two to be different conditions of the same species; but I think it will appear, from what will be subsequently stated, that even the shells of the '*proxima*' and '*vitrea*' exhibit a slight but constant variation, and that the animals are very distinct.

August 14, 1854.

I have just taken another lively example of this species, and I need only remark, that the peculiar gait above mentioned was less apparent than in the animal already described; I am therefore inclined to consider it of that nature which may be observed in the *Rissoæ*, when in creeping they arrive at the level of the water, and commence exserting and retracting with rapidity the buccal apparatus.

In the animal just discovered the curious tails of the foot were well developed, the angle of separation being about that of the fore and middle finger of the hand when placed as far apart as possible. In all the animals which I have observed I never met with a similar termination of the main foot.

R. VITREA, Montagu.

R. vitrea, Brit. Moll. iii. p. 125, pl. 75. f. 5, 6, and iv. p. 264.

The animal occupies a pale yellow essentially smooth shell, of 4½ tumid, though less rounded and more taper volutions, with shallower sutures than in the *R. proxima*. The general colour of the animal is very pale dirty-white. The mantle does not protrude beyond the aperture. The head or rostrum is subcylindrical, double the length of that of the '*proxima*,' invested with a tunic to near its extremity, grooved above, emarginate at the end, forming two minute, flat, symmetrical, arcuated, terminal lobes, vertically cloven beneath as in *R. parva*; the colour on both surfaces is a moderately suffused pink, through which the buccal apparatus is visible; and when the neck is much exserted it appears coloured with pale pink hues. The tentacula are flat, much longer than in the '*proxima*,' but not clavate like it at the tips; they have however the same fine, sharp setæ at the extremities; the eyes are at the centre of the bases of the tentacula, not raised, nor half the size of those of its congener. The foot is truncate in front, very slightly labiated, with unusually short obtuse auricles; not bifurcated posteriorly, but has an entire, somewhat taper and rounded termination, not extending beyond the second volution: the operculum is fixed on a simple lobe, scarcely distinguishable from the upper part of the foot; it is rather

more circular than in the last species, but, though paucispiral, the turns are less distinct, the oblique striæ of increment coarser, and the colour instead of being clear white is a dull yellow. All this is different in the '*proxima*.'

The examples now described are the only two that have occurred of this rare animal; it and the '*proxima*' were placed in the same glass, and, being lively, I had good opportunities for comparison; the animals are organically different, but I think the '*proxima*' is a greater departure from the Rissoidean type than the '*vitrea*'; still it will probably remain with the *Rissoæ*, though some of the specialties are on the verge of generic deviation.

In the remarks on these species I fear that conciseness is neglected, but the confusion in which they have long been enveloped must be the apology, as, without the present close examination, the doubts of their identity or distinctness would still have remained, and the slight, though constant, difference of contour in the two would by many be considered accidental.

It may be useful to the shell collector, to the younger student, and as a memorandum of the remaining desiderata of this genus, to offer a few short remarks on all the British *Rissoæ* not enumerated above.

The animal of the elaborately sculptured *R. striatula*, the most elegant of the *Rissoæ*, if it be one, still escapes observation. I have taken some delicate specimens in the coralline district, and yet hope to see the inhabitant.

The *R. lactea* of Michaud I do not know, but from the figure in 'Brit. Moll.' I should have judged it a variety of the *R. reticulata*, one of the large, short, tumid shells, and would have said the same of the *R. abyssicola*, if it had not been considered distinct by Professor Forbes. The *R. crenulata* is the well-known *Turbo cimex*, as the *R. calathus* is the old '*calathiscus*' of authors: neither of the animals are recorded. The *R. Zetlandica* is a well-established northern species, but the inhabitant is unknown.

An account of the *R. cingilla* has appeared in the 'British Mollusca.' The *R. pulcherrima*, nonnull., is a dwarf, nearly ribless *R. inconspicua*, which is one of the most variable species in form, size and markings. In comparison, care must be taken not to examine what is called an adult *R. pulcherrima* with a young '*inconspicua*' of the same size, but of larger growth, as it may lead to false ideas of distinctness: adult shells, of whatever growth, and in like manner, young shells, must be compared together, as the aperture in the two conditions is very different, there being in that of the young ones always a subangularity, but in those with completed peristomes it is nearly orbicular.

I have lately received some minute shells collected in Zetland; I have met with them occasionally on the South Devon coast. They are a partly dwarf or immature variety of that singularly variable species the *Rissoa inconspicua*, and are marked in the direction of the axis with about seven brownish-red lines that are tolerably regular and equidistant. I believe they are the long-lost species of Adams, "lineis rubris notata. Apertura margine patentissima." (Linn. Trans. vol. iii. p. 67.) With respect to the thickened or broad margin, it is rarely seen but in the completed shell, whether it be dwarf, or of a larger growth; and in the variety styled *pulcherrima* it is mostly wanting, probably in consequence of a depauperation from littoral causes, as the *R. inconspicua* is usually a deep-water or coralline zone species.

The so-called *R. eximia* is an undoubted *Chemnitzia* allied to *C. excavata*; I have described the shell, the animal being undiscovered, under the title of *C. Barleei*. I cannot speak of the *R. anatina* and *R. ventrosa*, not having met with them alive.

The *Turbo subumbilicatus* of Montagu is still in obscurity; it is perhaps a variety of one of the species of the estuaries, and if it could be identified, its position would probably be in this genus. I mention the *Jeffreysia diaphana* and *J. opalina*, because they have recently been styled *Rissoæ*; they appear from several characters to form the passage to the *Chemnitziæ*. I think I have now named every *Rissoa*.

I conclude this still imperfect monograph by calling on the naturalists of this branch of science to make it more complete, by searching in their respective localities after the animals which continue to elude our view.

The following *Rissoæ* have not occurred to us alive :—

R. STRIATULA, Montagu.
R. striatula, Brit. Moll. iii. p. 73, pl. 79. f. 7, 8.

R. LACTEA, Michaud.
R. lactea, Brit. Moll. iii. p. 76, pl. 79. f. 3, 4.

R. ZETLANDICA, Montagu.
R. Zetlandica, Brit. Moll. iii. p. 78, pl. 80. f. 1, 2.

R. CRENULATA, Michaud.
R. crenulata, Brit. Moll. iii. p. 80, pl. 79. f. 1, 2.

R. CALATHUS, Forbes and Hanley.
R. calathus, Brit. Moll. iii. p. 82, pl. 78. f. 3.

R. ABYSSICOLA, Forbes.
R. abyssicola, Brit. Moll. iii. p. 86, pl. 78. f. 1, 2; (animal) pl. J.J. f. 3.

R. CINGILLUS, Montagu.
R. cingillus, Brit. Moll. iii. p. 122, pl. 79. f. 9, 10; (animal) pl. J.J. f. 4.

R. ANATINA, Draparnaud.
R. anatina, Brit. Moll. iii. p. 134, pl. 87. f. 3, 4.

R. VENTROSA, Montagu.
R. ventrosa, Brit. Moll. iii. p. 138, pl. 87. f. 1, 5, 6, 7.

I introduce three new members to this family, the *Skenea planorbis* of the 'British Mollusca,' and the well-known *Cerithium reticulatum* of all authors. The '*planorbis*,' which I have for the second time examined, appears to be absolutely a discoid *Rissoa*, allowing the necessary margin for specialties of the shape of the foot, operculigerous lobe, tentacula and opercula. These organs greatly vary in the *Rissoæ*, and often differ more with each other, and the type, than even the discoidal '*planorbis*.' Ought there not to be two sections in *Rissoa*,—one for the elongated *Cerithium reticulatum*, which repeated examinations tell me does not exhibit a difference from it in any material point, and might, as respects the animal, be the type, instead of *R. parva*,—and

the other for the '*planorbis*,' which is equally a *Rissoa* of another form?

Is it to be contended, that because an animal has an elongated shell of twelve volutions, and another a discoidal one of three, it cannot be a *Rissoa*, and that such a departure from the type, in the shape and length of the shells, demands that the genus *Cerithium* be applied to the one, and *Skenea* to the other? I would ask, what is the classic number of volutions which stamp the Rissoidean animal? If the hard parts are the essence of the science, the organs of vitality become of secondary importance, and conchology rears its head again. If the shells are taken into consideration with the vital organs, ought the discrepancy in the form of the hard parts of a certain number of animals, or the identity of their organs, to determine the necessary genera?

It may be said that the so-called *C. reticulatum* has a canal at the base of the aperture: this is scarcely so; it is a mere contraction and attenuation at that part, giving an effuse aspect. The mantle is even with the shell, without a canaliculation. Many of the *Rissoæ* have these parts quite as much developed. Again, it is said that its operculum and that of the so-called *Skenea planorbis* are suborbicular: I say, not more so than some of the *Rissoæ*; and both these animals have very much the same paucispiral rapidly-increasing character of the opercular increment as in the *Littorinæ*. I think that the *C. reticulatum* and *S. planorbis* differ less from the Rissoidean type, the *parva*, than any other of the *Rissoæ* admitted by authors into that genus. If these positions are not admitted, we ought, to be consistent, to manufacture a separate genus for every petty variation of each *Rissoa*, and expunge the term 'species' from the molluscan vocabulary.

* *Discoidalis.*

R. PLANORBIS, nobis; O. Fabricius.

Skenea planorbis, Brit. Moll. iii. p. 156, pl. 74. f. 1, 2, 3; (animal) pl. G.G. f. 1.
Helix depressa, Montagu.

Animal yellowish-white, with a smooth umbilicated discoid

shell of three volutions of the same colour. Mantle simple. Head a produced wrinkled muzzle, with a vertically cloven yellowish-white disk, armed with the usual jaws, corneous plates and tongue. The tentacula are short, flattish, blunt, hyaline-white, not setose; eyes large, black, on mere prominences at the external bases. Foot long, rather thick, though narrow, slightly auricled, superficially labiated, and tapering to a moderately elongated rounded termination. The operculigerous lobe is much extended, well developed, narrow anteally, dilated in a subrotund form posteally, tinged with dark smoke-colour at the sides, edges, and on the upper surface; its extremity is of much the same shape as the main foot or sole; it does not terminate in a distinct cirrhus; indeed, the trace of one is obsolete. On the centre of this upper lobe, considerably distant from the end, is fixed a suborbicular operculum, that has much the same character of the rapidly-increasing paucispiral turns as most of the *Rissoæ*; the under surface of the foot is flake-white; the upper part and neck are marked with irregular, transverse, very fine, close-set, pale lead-coloured lines. The animal, therefore, is a simple Rissoid of discoidal figure, showing less deviation from the type, *R. parva*, than most of the *Rissoæ* with each other. I feel pleasure in having the sanction of Professor Forbes to this determination, who observes, in the 'British Mollusca,' vol. iii. p. 156, "the *Skeneæ* may be said to be discoid *Rissoæ*."

The animal exhibits the organs freely, as I have remarked is the case with all the littoral species, probably from the frequent exposure of the branchial plume to the influence of free air. This little creature marches rapidly, and is plentiful on the finer algæ of the pools, at Exmouth, in the half-tidal levels.

It has been objected, that the shell does not show the varix at the external lip of the aperture, as in many of the *Rissoæ*. This objection is of no value, as many accredited *Rissoæ* have not the callus; amongst them, *R. fulgida*, *R. soluta*, *R. vitrea*, *R. proxima*, and others. And as to the foot being rounded at its posteal extremity, that form is not uncommon in this

group, but if observed attentively, it will often assume the more pointed termination of the *Rissoæ*; it is also, as in them, a little constricted below the anterior end, and has on the sole a slight, mesial, longitudinal depressed line.

The next species is the so-called *Cerithium reticulatum*, but as there is already in the Rissoidean list the *R. reticulata* of Montagu, the specific title should be changed: it is proposed to substitute *vulgatissima*, an appellation of great significancy in respect of this animal.

*** Elongato-turrita.*

R. VULGATISSIMA, nobis; Da Costa.

Cerithium reticulatum, Auct.
————————, Brit. Moll. iii. p. 192, pl. 91. f. 1, 2; (animal) pl. I.I. f. 2.
Murex reticulatus, Mont.

Animal occupying an elongated dark brown shell of 10–12 spiral volutions, furnished with close-set costellæ and spiral striæ, which, at the point they cross the riblets, exhibit the moniliform sculpture of four points on each. Mantle plain, forming a small dilatation to correspond with the shell. The head is rather a long muzzle, anteally vertically cloven, and marked with nearly black, thickly-set transverse bars. The buccal apparatus is strictly Rissoidean, composed of a pair of jaws and lingual riband, which are perfectly white, supported by pinkish corneous plates, which can, through the tenuity of the under part of the muzzle, be seen in action, as in the *Rissoæ*. The animals are very voracious; we observed many sucking in ropes of molluscan mucus with great gusto and avidity. The tentacula are rather strong and short, not very pointed, yellow, and irregularly aspersed with flake-white and lead-coloured blotches. Eyes on distinct but very short pedicles at the external angles. The foot is rather short, truncate in front, very slightly auricled, and constricted anteally, but well labiated, and tapers to a moderately-pointed termination; on the upper surface pale yellow, mixed with darkish smoke-coloured points; on the under part, or sole, with longitudinal patches on each side of the palest lead-colour,

suffused with lemon-yellow, and studded with distinct flake-white points; there is very little trace of a depressed medial line on the sole.

A subcircular, paucispiral, corneous operculum, with a subcentral nucleus, is fixed on an *alated*, very elongated upper lobe, narrow anteally, dilating behind, marked with minute smoke-coloured blotches at the sides and edges, as in *Rissoa*, and with more intensity on the upper surface. The operculum is placed on a circular dilatation at the centre of the lobe, which is produced considerably beyond it to a blunt, though lanceolate-shaped point, which laps on the upper surface of the posterior part of the foot, at some distance from its termination, and appears to be the *locum tenens* of the typical Rissoid cirrhus, though it is not what is understood as strictly cirrhal. These sort of pedal filamentary appendages are of no generic value, and from the uncertainty of their presence in many of the *Rissoæ*, of scarcely specific importance.

This species is perhaps the commonest that exists; it is most abundant on the lower littoral levels; the animal is omnivorous, feeding on animal matters, and on *Algæ* and *Corallina officinalis*; it is equally plentiful in the deepest sea districts; its variations in figure are endless; every locality has its variety. The animal is as free as the typical *Rissoæ* in showing its organs.

These notes show that this so-called *Cerithium*, in organic structure, is a perfect *Rissoa*. Even the shell, as in that genus, has the characteristic varix at the outer lip, and in the pauses of growth, similar varices declare that the aperture is always, when the animal is not on the increase, provided with the *typical* callous pad.

We conclude by observing, that if the *R. parva* be considered the type of the genus, and it be not at hand, the *R. planorbis*, or *this species*, malacologically, has greater and more appropriate claims to act as a vice-type than any other *Rissoa* in the list. We cannot comprehend how three genera can with propriety be constituted from essentially identical animals.

We think that the *Murex adversus* of Montagu—a *Ceri-*

thium with some authors—an unobserved animal, will, from its paucispiral operculum, so similar to the present species, probably, *as a Rissoa,* join its elongated dextrorsal comrade. We have never seen it alive, but it ought to be observed, as it is not very uncommon on the Plymouth and Cornish coasts.

With respect to the shell called *Cerithium metula,* it is transferred, *ad interim,* as a congener of *Murex tubercularis.*

R. UNICA, nobis.

Aclis unica, Brit. Moll. iii. p. 222, pl. 90. f. 4, 5.
Chemnitzia unica, Alder et nobis.
Turritella unica, Fleming.
Turbo unicus, Mont. et Auct.

Exmouth, 29th June, 1854.

I now give an account of a very rare mollusk which I discovered this day, and which has hitherto evaded, in a living state, all our researches; I have sought it for thirty years, and may therefore sing "Io Pæans" with the illustrious author of the 'Amorum,' since at last, as with him—

"Decidit in casses præda petita meos."

Let this instance of unexpected success impress on us the value of the "nil desperandum." The discovery of this creature has long been a desideratum, as it will solve several malacological questions: it has from Montagu's time run the gauntlet of nearly all the genera, agreeably to the conchological surmises of naturalists, of whom scarcely two are in accord, and all in error; as my notes require me to place it in a position it has never yet occupied, and which, I believe, will prove to be its true malacological *status.* Our ignorance of every circumstance attendant on this almost microscopic being has invested it with a strange diversity of position and consequent structure; but the light of discovery that now dawns on us will dissipate, as in every case, misapprehensions, and tell us the Fates have decreed, that we all should be at fault about a very simple creature, which, though not absolutely a typical *Rissoa,* is all but one, as the shell only wants the callus on the outer lip; but we have many admitted

Rissoæ without that appendage; indeed, if we were to look for *strict* typical specialties in either the hard or soft parts of any mollusk, every species must become a genus.

Shell.—Of eight yellowish-white, rounded, finely reticulated volutions with oblique well-marked sutural lines. The apex is obtuse and not reflexed, as stated by me in another place: I was deceived by imperfect specimens, which led me into the error of supposing that it would prove a *Chemnitzia*.

This is one of the slenderest British shells, having only an axial admeasurement of $\frac{1}{12}$, and a diameter of $\frac{1}{40}$ unciæ; the outer lip is thin, and the aperture is oblong-oval and almost entire.

Animal.—The general colour is hyaline-white, shot throughout all its organs with a mixture of very minute close-set points, short lines or blotches, of flaky and frosted snow-colour. Mantle even with the shell, except that at the apertural upper angle it emits the filament I have so often mentioned as being present in all the *Rissoæ*, and whose particular function is doubtful. The muzzle is slender and rather long, having the first half from the neck, on its upper part, clothed with a very close tunic or tight overlay; the disk is smooth, compressed, bevelled to a fine edge, and almost circular, with a median vertical fissure on the under surface, in which I have often seen the delicate white corneous plates, jaws, and lingual riband; but great powers and much time are required to seize a favourable opportunity of vision in so minute and restless a being. The tentacula are very like those of *Rissoa striata*, moderately long, flat, rounded or obtuse at the tips, quite smooth even under high powers, divergent, with large black eyes, not on pedicles or prominences, but fixed on the centre of their bases with very little external inclination, and widely apart; there is no connecting tentacular veil, nor the least triangularity, foldings, or the presence of apical inflations, as in the *Chemnitziæ*; on the march the eyes are usually carried within the margin of the shell. The foot is slender, greatly hollowed out in front and deeply labiated, with distinct, long, arcuated linear auricles which play on the march, or, as

M. Lovèn would term it, "*læte vibrantes*," beneath which it is slightly constricted, and a little beyond the middle, posteally, is fixed on a simple lobe without lateral expansions or terminal cirrhal filament; the light yellow suboval operculum with distinct grossly-spiral turns, exactly as in the paucispiral *Littorinidæ*; below the operculum the foot is visibly contracted on each side, and terminates in a rounded, rather broad point; no median line is apparent in any part of the sole.

This creature is not at all shy; it remained lively for thirty-six hours, and gave every facility for good examination; it readily creeps up the deepest glasses, and however often brushed down, starts again with unabated vigour. The specimen described was detected in Littleham Cove, between Exmouth and Budleigh Salterton, in the littoral level, in debris of minute decayed shells mixed with sand and mud that had an offensive odour, the mass being deposited on the margins of deep quiet pools affording nutriment to certain long, narrow, grassy sea-weeds. I have been thus particular, to obviate difficulty to future naturalists, and I wish them success in obtaining a live specimen with less trouble than I have had.

The habitat of this species is, I believe, strictly littoral; its associates are the *Rissoa parva, R. striata, R. planorbis,* nobis, (*Skenea planorbis,* auct.), as these are found in the same mass of spoil.

That this is a Littorinidan and almost a strict Rissoidean animal, allowing a trifling margin for specialty-variations, admits of no doubt. It has no malacological community with *Turritella, Aclis,* or *Chemnitzia*; but as the muzzle is carried in nearly a similar position as in the latter genus, the young malacologist must take care in so small an object not to be misled by this circumstance, or by the centrality of the eyes at the base of the tentacula: the veteran observer with delicate and apt manipulation, patience, and good glasses, will easily detect the vertically cloven disk and corneous jaws, which, with the rissoid simple tentacula, will demonstrate that this animal is merely an elongated *Rissoa*.

?? R. ADVERSA, nobis.

Cerithium adversum, Brit. Moll. iii. p. 195, pl. 91. f. 5, 6.
Murex adversus, Montagu.

If the animal should be found to have a floating respiratory mantellar canal and a proboscidal head, it will of course belong to *Murex*; but I do not believe that any Muricidal species has a laxly spiral operculum. I therefore repeat that the '*adversus*' belongs to the *Cerithium* of authors, which is only another term for an elongated *Rissoa* that has a spiral operculum, long strong muzzle, armed with a lingual riband, doubled into a pair of jaws at the anterior extremity.

ASSIMINIA, Gray, Leach.

A. GRAYANA, nonnull.

A. Grayana, Brit. Moll. iii. p. 70, pl. 71. f. 3, 4; (animal) pl. H.H. f. 6.

We believe that this genus and species will merge into *Truncatella*. See the remarks on *T. littorea*.

Animal spiral, yellowish-brown; mantle simple; head with a moderately long, deeply-cloven annulate muzzle. Eyes at the extremities of pedicles soldered to the shortish blunt tentacula, being of concurrent length with them; a canaliferous groove runs from their bases to the branchial cavity. Foot large, broad, auricled, truncate in front, with an obtuse posterior termination, double-lobed; the upper one, being much the smaller, carries the usual horny, suboval, spiral operculum of the *Littorinæ*. It inhabits in sufficient abundance the small streams which discharge into the Greenwich marshes, but generally within the reach of the tidal and brackish waters. The animal has not occurred to us.

TRUNCATELLA, Risso.

Exmouth, June 8, 1853.

Mr. Wm. Thompson, of Weymouth, has this day favoured me with some lively examples of the rare *Truncatella Montagui* in its adult and young states, that is, before and after the truncature of the apex, and also others of the still rarer *Rissoa*

littorea of authors. These, though sent by post in moistened weed, which however was quite dry when received, on being put into sea-water immediately deployed the organs. The first has been described by the Rev. R. T. Lowe, many years ago, in the 5th volume of the 'Zoological Journal,' p. 303; and the *R. littorea*, by the learned authors of the 'British Mollusca,' in the Appendix, vol. iv. p. 265; still, as my account contains many new particulars, and notes a difference of opinion in respect of the generic position of *R. littorea*, I have thought it would be agreeable to some readers to have a description of these rare creatures from a fresh though inferior hand, especially as the present notes exhibit a comparative view of both animals, which were examined for two days in the same vase under very favourable circumstances. It is singular that these species, both undoubted Pectinibranchiata, should inhabit at high water level, in company with *Conovulus denticulatus* and *C. bidentatus*, both Pulmonifera, and are, as Mr. Thompson has informed me, "decidedly amphibious," being often found far above that limit; but I apprehend not more so than many of the minuter *Littorinæ*, particularly *L. neritoides*, which are attached to rocks for long periods, perhaps during their whole existence, above the highest tides and even beyond the reach of the spray, living apparently on the floating saline moisture. It would appear then that the two respiratory systems are in respect of these animals on the limits of their respective boundaries, and form the transitions from one to the other. Both the Pectinibranchiates escaped from the water as quickly or quicker than the Pulmonifera, but all the former, whether littoral or from deep water, have the same propensity; therefore this fact is of little value; yet, when strictly confined, the *Truncatellæ* continued lively for two days, whilst the *Conovuli* became torpid in twelve hours: perhaps we may conclude, that these littoral Pectinibranchiata and the sublittoral Pulmonifera are to a certain extent amphibious. All these species were taken mixed together in an estuary at Portland, by Mr. Thompson, who states that they are very rare and local.

T. Montagui, Lowe.

T. Montagui, Brit. Moll. iii. p. 317, pl. 99. f. 1; (animal) pl. F.F. f. 10 (as *T. truncatula*).

Animal, when adult, occupying a yellow or whitish subcylindrical shell of four flattish volutions, deeply divided, and furnished with close-set, somewhat irregular costellæ; when young, before the apex is truncated, of 6–8 smoother and more taper gyrations. The peristome, in the completed shell, is entire, having the outer lip blunt and a little reflexed; with respect to colour, it is of the palest yellowish-white, aspersed with very minute flake-white points, particularly the foot, with a patch of pink on the neck, caused by the colour of the buccal corneous plates showing through the pellucidity of the tissue. The mantle is plain and even with the shell, but rather tumid at the margin: I did not observe much approach to the mantellar collar of the *Helices*. The rostrum is ridged or annulated, long, very broad, flat, emarginate at the end, forming on each side a curved compressed auricle, and cloven underneath vertically and slightly crosially; buccal apparatus reddish-pink. The tongue at its deeply-seated terminus displays a pair of white jaws; it can be seen through the œsophagus, and is accompanied on each side by a linear streamer floating loose posteally. I am not certain whether these narrow, tape-like additions proceed from the buccal membrane or tongue, — I think the latter, — or they may possibly be salivary glands.

The branchial plume is single, of an elongated, kidney-shaped figure, and has the usual constriction or sinus at the end nearest to the heart; it can be detected with high powers in sunlight, through the body volution of pale, clear, thin shells; all the rest of the organs, including the single pale brown ganglion on each side the œsophageal collar on its upper surface, may be easily seen through the hyaline tissue of the neck and head. The flexible neck, and rostrum from its corrugations, can be protruded to an extraordinary extent beyond the aperture. The head far exceeds the tentacula in length; these are short, flat, broad, subtriangular, and diverge greatly, scarcely

forming an angle of 25°. The eyes are large and black, and have *white* prominent pupils, which visibly dilate and contract. I have never observed such in any mollusk, though similar ones may have escaped notice: they are placed a little nearer to the base than the middle of their lower half, not on pedicles, but quite flat on the centre of subsemicircular expansions of the outer sides of the tentacula, with an external tendency. Foot thick, steep, oval, very little extended, and on the march maintaining posteally and anteally the oval contour, with a vermicular motion, like an advance of one half to the other; this action gives an apparent crease, simulating an incised transverse line, but on the step being completed, the foot becomes entire. It carries very posteally, on a plain upper lobe, without an appendage of any sort, a narrow, irregularly oval, light yellow corneous operculum, rounded at the outer margin and basally, straighter next the columellar side, and contracted at the upper angle; the nucleus of the spire is at the base, with a single turn, which, though indistinct, is in certain lights, with good glasses, quite visible; its surface is coarse and corrugated, and marked with rough, somewhat oblique, not equidistant striæ or ridges. The rostrum is medially longitudinally finely grooved, which character extends through the neck as far as can be seen, probably as a guide-channel to the branchial leaf. The neck, with this exception, is plain. The animal is not shy, but does not creep with much rapidity; its progression is a modification of the littorinidan vermicular character.

That *Truncatella* is a Littorinidan genus admits of no doubt; the very paucispiral operculum, pair of jaws, and single branchial plume sufficiently attest this determination; its position is of course closely connected with *Rissoa*.

T. LITTOREA, Delle Chiaje.

T. littorina, Philippi, Moll. Siciliæ.
Rissoa et *Assiminia littorea*, nonnull.
R. littorea, Brit. Moll. iii. p. 132, pl. 81. f. 6, 7; (animal) pl. M.M. f. 3 *a*, 3 *b*, and iv. p. 265 (as *Assiminia*).

Animal inhabiting a minute pale yellow shell, not $\frac{1}{10}$th of

an inch high, or, in transverse measure, of four rather tumid volutions, the first three of small area, the body being more than ⅘ths of the bulk of the whole. Under powerful lenses, in some specimens, the rudiments of the longitudinal costellæ or striæ of *Truncatella Montagui* are visible, an important corroborative character; the peristome is complete, but sharp-edged. The animal is of the palest yellowish-white, sprinkled with excessively minute, flake-white points, particularly on the sole of the foot, with the slightest tinge of brown on the neck, the effect of that colour in the buccal plates declaring itself through the membranes. Mantle plain and thickened at the margin. Rostrum annulated, but not so long in proportion as in its congener; broad, flat, emarginate at the extremity, forming on the right and left a flattish arcuated lobe; beneath, vertically and slightly crosially cloven, having the usual corneous buccal plates, tongue, and pair of white jaws. Tentacula very short, broad, flat, rounded at the end, divergent, both in quietude and on the march, carried at almost right angles with the front of the head, with large eyes and dilatable white pupils as in the preceding species, placed not positively at their terminations, but on the centre of the membrane, at some distance from the extreme points. This was particularly remarked; but the very powerful lens used would give them that appearance, which of course would not be so apparent when viewed by a common glass; though, nearer the extremity of the tentacula, the characters are precisely those of *T. Montagui*, and a similar white pupil is a singular coincidence. The neck, as in its congener, has the same longitudinal groove or canaliferous lines running medially through the rostrum and neck to the branchial leaf, and is doubtless an aqueduct. The neck and rostrum in quietude appear short; they are so in *T. Montagui*, but can in like manner be greatly extended, though not proportionately so much. For these reasons the œsophageal streamlets and nervous ganglions were not seen: but I distinctly observed, through the tenuity of the shell, the kidney-shaped respiratory apparatus with the constriction at the end nearest to the heart, and clearly detected the fine blood-vessels of the reniform loop

ranged in transverse order. The only difference observable in the two species is, that in this, the leaf appears of a shorter or more oval contour, more compact, and with a less deep constriction; the neck and rostrum have no additions beyond the groove and annulations. Foot thick, having a more elongated oval shape than in its congener, and, as in it, rounded in front and behind on the march; it simulates the same transverse crease or line on the sole, and has a like character of progression. There is a simple, almost terminal, but decided operculigerous lobe that bears a light corneous suboval operculum, which in all points, except being of lighter colour and broader oval, is identical with that organ in the preceding species, to which I refer; indeed, so great is the similarity of the two animals, that I might, by a reference, have condensed the greater part of this account; but as these notes are decidedly comparative of two particular creatures, I have given them *in extenso*. The animal is free, but deliberate on the march, and carries its shell very upright, at nearly an angle of 75°–80° from the horizon.

It will be seen that this account is essentially the same as the one in the 'British Mollusca,' except that the learned authors have proposed to deposit it in *Assiminia*. I think its generic position is with *Truncatella*. A comparison of the two species will show that they are not only identical in the principal characters, but that almost all the minutiæ are congruous. Indeed I may say, that these gentlemen differ from me little more than in the name, '*Assiminia*,' which I would gladly accept for *Truncatella* for the reasons below, if such a change in nomenclature were not forbidden by strict conventional laws. As far as I can learn, not having seen the animal of *A. Grayana*, the genus *Assiminia* scarcely varies, if at all, from *Truncatella*; at least the generic characters given in the 'British Mollusca' are absolutely those of that genus, except some difference in the position of the eyes, which I should not be surprised to find greater in terms than in reality.

The generic title of *Truncatella* is objectionable, as being in this case too distinctive, and therefore only strictly applicable to *Truncatella Montagui*, whilst two, if not three, of our

indigena, *T. littorea*, *T. Grayana*?, and *T. nitidissima*? are never truncate at the apex; still, this appellation has been so long established, that it is better to continue it than add new names to science:—the latter remarks are M. Philippi's sentiments. We have here a striking illustration of the value of concholo-gical-made genera, since, in consequence thereof, three species of one genus have received as many generic titles, from their shells exhibiting a subcylindrical, a conical, and (if the *Skenea*? *nitidissima* of authors is the *T. atomus*? of Philippi, as is probably the case) a discoid form.

I see no reason to doubt M. Philippi's *Truncatella littorina* (Moll. Sicil. vol. ii. p. 133, tab. 24. fig. 2) being our present species; the description and figure entirely accord.

? T. ATOMUS, Philippi ?

? *T. atomus*, Philippi, Moll. Siciliæ, ii. p. 134, pl. 24. f. 5.
? *Helix nitidissima*, Adams.
? *Skenea nitidissima*, Brit. Moll. iii. p. 158, pl. 73. f. 7, 8, and iv. p. 269.

This, probably, is M. Philippi's species; it is placed provisionally, until some of the Scotch naturalists have supplied notes on the animal, which is abundant on their coasts. It is also taken in Ireland.

Since the above remark, we have examined our specimens, which fortunately proved to have been taken alive, and find that the operculum is precisely of the same grossly spiral character and sculpture as in *Truncatella Montagui* and *T. littorea*; moreover, the eyes in the dried animal are perfectly visible, and show the characteristic white pupil of what may now be safely termed its congener.

TORNATELLIDÆ.

TORNATELLA, Lamarck.

T. FASCIATA, Linnæus.

T. fasciata, Brit. Moll. iii. p. 523, pl. 114. D. f. 3; (animal) pl. V.V. f. 7.
Voluta tornatilis, Auctorum.

The following notes are from M. Philippi, 'Enum. Moll. Siciliæ,' vol. ii. p. 143:—

"Animal not differing materially from *Bulla*. Colour white. An oblong foot, a little longer than the shell, truncate in front and auricled; obtuse behind, carrying a small, elongated, narrow, arcuated operculum, with the muricidal character of the striæ of increment. The head is flat, divided from the foot by a deep groove coalescing with the tentacula, anteally a little dilated, "medio excisum?," divided above by a longitudinal mesial furrow, terminating posteally in two lanceolate lobes reflected on the middle of the shell. Two small eyes in the middle of the head."

This is the only species of the family, and belongs to the bisexual fifth division; nevertheless it has some alliance with the aberrant *Limneadæ* and *Bullidæ*, and forms an excellent transition-genus to the *Pyramidellidæ*, with which it is in much closer alliance than with *Bulla*, by the presence of a more developed columellar fold, reflexed apex, *corneous operculum*, pendent *organe générateur*, and also by bisexuality, instead of congressional hermaphroditism. We may also mention, that no true *Bulla* exists with an operculum, and in this instance it is of muricidal sculpture. *Tornatella* has no gizzard, but no *Bulla* is without one. This animal seems to hover on the confines of the *Bullidæ*, *Conovulidæ* and *Pyramidellidæ*, and has a cross with the *Cypræadæ*; but the balance of characters is greatly in favour of its present intermediate position.

HETEROPHROSYNIDÆ, nobis.

We have constituted this family to receive the genus *Jeffreysia*, as yet of only one species, though one or two more may eventually be added. The reasons for the present proceeding are, that in our judgment it would not have been satisfactory to place an animal with organs so anomalous amongst the *Littorinidæ*, and, though much more closely related to the *Pyramidellidæ*, it could not be deposited therein without an inconvenient alteration of some of the characters

of that family; *no other can receive it*, and it is only by this mode we have escaped from our dilemma.

JEFFREYSIA.

J. DIAPHANA, Alder.

J. diaphana, Brit. Moll. iii. p. 152, pl. 76. f. 1.

Animal inhabiting a thin, glabrous, snow-white spiral shell of four and a half tumid volutions. Mantle pale yellow, even with the shell. The head is short and flat, and so deeply cloven as to form two distinct flake-white divergent spatulate lobes, with the mouth at the angle of the fissure. These processes have the appearance of a pair of tentacula, but the true ones are external to them, of hyaline flake-white, not very slender nor pointed, and are rather longer than the pseudo-tentacula. The eyes are large, black, placed very far back, on small, very slightly raised eminences, surrounded by a lucid spot or circle issuing from the skin a little within the internal portion of the bases of the tentacula; they are never exposed, but always carried on the march within the shell, where, from its hyaline nature, they can easily be seen. Foot rather long, but not slender, auricled in front, gradually tapering to a rounded point without any sort of caudal appendage, but with a slight longitudinal medial line on the under surface. The subtestaceous operculum is placed at a little distance from the posterior upper termination of a simple operculigerous lobe; it is of suboval form, pointed at one end and rounded at the other; it has marked subannular striæ of increment, and is of very pale colour. We have omitted to mention that the operculigerous lobe extends laterally a trifle beyond the pedal disk, forming very narrow arcuated segments. The whole of the foot beneath, as well as at the posterior end above, is pale yellow, but the upper anterior portion with the neck and head, from the mouth posteally, is marked with excessively minute, close-set, red-brown points. The three posterior volutions are occupied by the viscera, comprising an intensely dark red-brown liver, which, with the

ovarium, when present, between the lobes, are very conspicuous through the tenuity of the shell.

The animal is not shy; it shows the organs freely and marches with vivacity; it also swims and floats with perfect ease, as is usually the case with all the smaller and shorter *Chemnitziæ*. It has frequently occurred in the quiet half-tidal pools at Exmouth.

? J. OPALINA, nonnull.

? *J. opalina*, Brit. Moll. iii. p. 154, pl. 76. f. 3, 4, & iv. p. 267, pl. 133. f. 6; (animal) pl. M.M. f. 2.
J. globularis, Brit. Moll. iv. p. 268, pl. 133. f. 5.

Live specimens of the beautiful so-called *Rissoa opalina* were received in a bottle of sea-water, from my friend Mr. George Barlee, at Falmouth, whose laborious and painful journeyings—

> ..... "per omnes
> Terrasque, tractusque maris,"

of the wilds of the Ultima Thule and Hebridean seas, have enriched science with so many rare and interesting objects; the present one is invaluable, as it clears up several doubtful questions which might long have remained unexplained, if this curious animal had continued to escape observation. Though somewhat torpid, I have observed the organs, an account of which, I am sure, will gratify many of my readers. There is no recorded description of the animal.

Animal inhabiting a spiral, smooth, thin, white, subglobose shell of three volutions. Mantle of the palest azure, slightly canaliculated, otherwise even with the shell. The head is a rounded, short, contractile, proboscidiform muzzle, which is rarely carried beyond the foot and tentacula; it is vertically cloven at the terminus and under part, and furnished with a pair of subcircular jaws and lingual riband, which in several of the examples I frequently saw protruded after the manner of the *Rissoæ*; the head and neck are brindled with fine dark lead-coloured lines.

There are a pair of tentacula on each side the neck behind the muzzle, springing from a distinct common origin or

pedicle, not formed by the fissure of any part of the head, divergent, *very short*, thick, very little flattened, of nearly the same size throughout, each pair connate with their respective stamens, very moderately setose, quite blunt at their terminations, beneath pale yellow, above delicately aspersed towards the extremities with pale-coloured very minute points. The eyes are large, black, placed very far back on the neck, on very slight eminences, perhaps immersed in them, apparently in a line with the centre of each tentacular pedicle. These parts were seen with great difficulty, and only came into view in two examples; they however may be observed through the paler-coloured shells, but are not exserted on the march beyond the margin of the aperture. The foot is oval in quietude, showing a narrow lead-coloured margin, in action somewhat truncate anteriorly, with very small auricles, posteriorly forming a gradually attenuated termination, without cirrhi, but slightly emarginate in one or two specimens. The testaceo-corneous operculum is suboval, marked with fine subannular striæ, with a small central process, rib and groove, sometimes with two minute raised points or nuclei contiguous to each other; all these characters are occasionally subject to some modification. We have several in our cabinet which differ materially, the annular striæ of increment being usually permanent. The operculum is carried rather posteriorly, not on a developed operculigerous lobe. The foot is not labiated so as to produce a mentum—at least I saw none; it is not so slender proportionately as in the typical *Rissoæ*, nor so long; beneath it is pale yellow, showing a medial line on the posterior half; above, elegantly mottled or brindled with dark close-set lead-coloured lines, which are sometimes waved;—the colours on all parts vary in intensity in the different individuals. I could detect no head-lappets.

These animals float and creep like the *Chemnitziæ* and *Rissoæ*; they inhabit the littoral and laminarian zones.

Axis $\frac{1}{20}$, diam. $\frac{1}{30}$ unciæ.

The muzzle of this animal allies it to *Rissoa*, and the peculiar position of the eyes to *Chemnitzia*; further investigation is required to determine which is the most essential character.

Notwithstanding the proboscidal muzzle not being a strictly retractile one, I think the balance of characters is in favour of this animal being a transition-form from the *Littorinidæ*, and that it may be considered an aberrant *Chemnitzia*.

I have stated above, that the pair of tentacula on each side are not formed by a scission of any part of the rostrum. I believe that I am in error, in consequence of the minuteness and torpidity of my specimens. I think the *J. globularis* can scarcely be considered even a variety of the "*opalina*." It will not surprise me if the three so-called species, *J. diaphana*, *J. opalina*, and *J. globularis*, turn out to be identical, differing only through climate and habitat, and exhibiting the same phases as the variety of the *Littorina rudis* termed "*tenebrosa*," in its minute globular variations,—the "*neglecta*" and "*fabalis*" of authors. A rigorous examination of the peculiar internal aspect of the columella of the three so-called species, and the absolutely identical form of the operculum, even to the minutest portions of the sculpture, which certainly would not be the case if they were distinct, authorize me to express an opinion as decided as can be accorded to a shell inquisition, that the three are identical, and I cannot doubt that the animal of *J. globularis* will confirm this view.

BARLEEIA, nobis.

For many of the reasons stated in the introduction to the *Heterophrosynidæ*, and for those in the subjoined account, we have transferred the *Rissoa rubra* of authors to this family, as a new additional genus. Though *Barleeia*, like *Jeffreysia*, has some Littorinidan attributes, we think that both these genera differ sufficiently from that group to require being arranged in a new family between the *Littorinidæ* and *Pyramidellidæ*, with both which the two genera have relations, as well as with each other; and as some difference of opinion has existed with respect to the position of *Jeffreysia*, we have adopted for the family the significant title of *Heterophrosynidæ*.

Exmouth, June 26, 1853.

It is stated in a paper of mine on the *Rissoæ* in the 'Annals,' vol. x. p. 262, N.S., "that the *R. rubra* is very common alive in certain localities," and that "I have never seen the animal, and can scarcely believe it to be a true *Rissoa*, as the semi-testaceous operculum and its apophysis are more like those of a *Chemnitzia*."

This view is corroborated by the reception this day, by favour of Mr. Barlee, of many lively specimens, sent from Penzance in a bottle of sea-water by post, which has enabled me to take notes of all the organs. I am not aware that this curious, I may almost say, anomalous species, has ever been mentioned, beyond a very slight notice by one or two authors, which in most respects is so discordant with the animal now presented, that one would almost think some other had been inadvertently observed; perhaps a young example of the more tumid red-brown variety of the *Rissoa ulvæ*. I judge so, because authors describe their animal with very *long* and *setaceous* tentacula, whereas the true *Rissoa rubra* has those organs *particularly short and smooth*. M. Philippi's account is the best, but sadly deficient in the principal peculiarities of the animal. I think malacologists will be glad of a somewhat enlarged description.

B. RUBRA, Adams.

Rissoa rubra, Adams.
————, Brit. Moll. iii. p. 120, pl. 78. f. 4, 5, & pl. 80. f. 3.

Shell.—The colour is plain red-brown, smooth or slightly wrinkled, of 4½ to 5½ tumid volutions, which form a rapidly increasing cone. Aperture oval, entire, contracted above, rounded basally; outer margin sharp, without the callous pad of the *Rissoæ*. Axis $\frac{1}{10}$th, diameter $\frac{1}{17}$th of an inch.

Animal.—The mantle is plain, even with the margin of the shell, and without the filament seen at the upper angle of the aperture in many of the *Rissoæ*. Rostrum very short, not corrugated nor capable of much extension, brindled above with dark smoke-coloured, fine, irregular, close-set lines, below pale yellow; buccal disk of the same colour, of small

area, crosially and vertically cloven, containing the usual masticatory processes of the *Littorinidæ*; neck dark, but not so much so as the rostrum, quite plain and without appendages. Tentacula very short, strong, broad, not in the least setaceous, with perfectly rounded, somewhat spatulate extremities; they are not vibrated on the march; colour very pale yellowish-white, with a line of sulphur-coloured beads or minute flakes running centrally from base to point; eyes very large, black, fixed on bright sulphur inflations at the external bases. Foot an elongated, rather narrow oval, anteally arcuated, labiated, with scarcely perceptible auricular points, posteally rounded, emarginate in the centre of its termination; colour, in the middle of the upper part, confused flake-white, margined with a belt of pale smoke hue; sole pale yellow, with a decided depressed longitudinal line on the centre of the posterior half, not constricted under the slight auricles as in *Rissoa*, and not so slender. The operculigerous lobe is small, very little alated anteriorly, but expands below into a dark, flat, arcuated membrane; no cirrhus is visible, and I believe none exists; it carries a strong, red-brown, suboval, testaceous operculum, sharp above, rounded below and at the outer edge, and straighter on the columellar side. The structure of the fine striæ on the upper surface is of subannular figure, with a longitudinal furrow about the middle, which forms a raised rib on the under part, the whole of that area being thick, coarse and irregular, with, at the nucleus (which is nearer the base than the centre), a testaceous apophysis, more prominent than in *Jeffreysia*, and stronger and longer; indeed, as much so as in some of the *Chemnitziæ*.

These animals inhabit the lower littoral levels at Penzance; their locomotion is deliberate, and they evince considerable shyness. There are many fasciated varieties and a white one.

This animal approaches the Littorinidan group, and conducts from *Rissoa* to *Jeffreysia*: as the latter and it have analogous subtestaceous opercula and apophyses, they naturally lead to the *Pyramidellidæ*. But this species cannot be placed in *Rissoa* on account of the singular operculum (as the like is not seen in any species of that genus), and many other animal

discrepancies. Philippi unaccountably omits all mention of the principal peculiarity, the curious operculum, but he does say that the animal departs somewhat from those *Rissoæ* he has examined, both as regards the organs and the shell; and I add, that with the exception of the very short muzzle and depressed line in the after-part of the foot, there is not another external organ that has much concordance with the typical *Rissoæ*.

Neither can it be associated with *Jeffreysia*, which indeed agrees with it, essentially, in respect to the operculum; but the animals of the two are very different. I have therefore proposed for it a new genus, which ought, I think, with *Jeffreysia*, to form a family intermediate to the *Littorinidæ* and *Pyramidellidæ*. I have omitted to mention that M. D'Orbigny's subgenus *Rissoina* cannot receive it, as with a testaceous operculum and apophysis, it is of the spiral or Littorinidan type, whilst the present object is of subannular elements; and I consider the operculum, though so much neglected, to afford a most important generic and differential diagnosis; but independent of these points, I could not, agreeably to my views, accord with such an allocation. I repudiate all *subgenera*, which I consider as an awkward attempt to define what is undefinable—an intermediate condition between a genus and a species. I think, when a species is so discordant with the generic type, that it ought to merge elsewhere, and take on a substantive capacity and become the type of a new genus. There can be no objection to the term *sub* when used *adjectively* to qualify a word, as subannular, subrotund, and subsymmetrical, &c., but not *substantively*, as then it becomes the source of innumerable absurdities: with me a genus has no intermediate state beyond species and their varieties.

I would therefore submit to malacologists, as I have shown that no existing genus can with propriety receive this curious creature, that a new one be constituted for it, and entitled *Barleeia*, as a just recollection of the exertions of a gentleman who loses no opportunity of enriching science with living objects from the Great Book of Nature; and though

the present animal is locally common, it is malacologically an almost unrecorded rarity. We may all blush for our carelessness in not noticing this interesting and unique species, which, though within the range of many naturalists, would still, probably, have remained in obscurity, if it had not been *déterré* and forced into notice by our invaluable friend.

PYRAMIDELLIDÆ.

This family forms an important section in the ranks of British malacology, and consists of numerous species, which, though many of them have long been known to our older conchologists, have scarcely, until very lately, attracted the attention of continental naturalists, in consequence of their minuteness and the difficulty of obtaining the animal for examination. The only recent authors who have paid much attention to the malacology of these interesting objects are the Rev. T. Lowe, M. Lovèn, M. Philippi, and Professor Forbes.

The British genera comprise upwards of forty species, more than half of the animals of which I have examined, and think that detailed accounts of them will be acceptable to malacologists. These species have run the gauntlet through nearly the entire range of the British Gasteropodous molluscan genera in search of a resting-place. It is needless to allude to these ancient and variable depositaries; I will therefore only mention the recent genera in which they appear to have obtained that sort of improved provisional settlement, which is usually the precursor, from the many malacological facts that have been obtained, of a definitive natural position.

The more recent receptacles of these interesting objects are, Mr. Lowe's genus *Parthenia*, Dr. Fleming's *Odostomia*, M. Philippi's *Chemnitzia*, and the *Truncatella* and *Eulima* of Risso, with M. Lovèn's *Turbinella* and *Aclis*. The admirable manner in which Mr. Lowe has described the animal and illustrated his *Parthenia*, causes much regret that we must

concur with M. Philippi in not using this appellation, in consequence of the pre-occupation of the term. Though we believe Dr. Fleming's genus *Odostomia* has the priority of time, yet, from the variableness and instability of the principal conchological character, the fold on the pillar, it cannot be maintained either generically or as a group: for instance, the *Odostomia interstincta* often has the fold, and often is without it; the *O. indistincta* never has a tooth; the *O. excavata* is sometimes with and sometimes without it. Many of the more elongated and turreted species are without a fold; nevertheless in some, for instance the *O. acicula*, the tooth is present, and often wanting, as our cabinet will show; therefore the appellation of *Odostomia* to this tribe is incongruous and a complete misnomer. The term cannot even be admitted as a sectional arrangement, as it would separate individuals of the same species, for example the toothed *interstincta* and the edenticular one; on these accounts we are reluctantly obliged to decline the use of the term. Besides, we believe that this fold or tooth has had attributed to it far more generic value than it deserves: it probably gives some support to the body as a *point d'appui*; but the malacology of the animal, whether with or without it, affords no corresponding variation. We therefore propose to adopt M. D'Orbigny's genus *Chemnitzia* for those species with or without a tooth, smooth or plicated, many or few volutions, which have as a component of their specific characters a moderately long, retractile proboscis, and eyes at the internal bases of the tentacula. All these species cannot be mistaken, as whatever may be the specialties of the animals, they have the apical one or two turns reflected on the following descending one. This is a constant character; I have never met with a departure from it.

The next genus of this family is *Eulima*, which, though closely allied to *Chemnitzia*, is nevertheless distinct in various points to be mentioned. M. Lovèn's *Aclis* next succeeds as a Pyramidellidan genus, and only embraces one or two species. *Stylifer* is admitted provisionally. The natural position of this genus of one species requires further investigation, which, from its rarity, I fear may long be delayed.

I present an account of many of the animals of *Chemnitzia*, the most difficult of all the Gasteropodan genera; most of them have been submitted to repeated examinations. The present list is more than fourfold greater than any that has yet been recorded.

Before I enter on the descriptive matter, it will be proper to say a word or two in explanation of some of the organs of the very singular genus, which, in my method, includes the *Odostomiæ* and *Eulimellæ*, and a few of the species of *Aclis*.

With respect to the organs of the animal, I will first mention the peculiar anterior process styled by most authors the mentum, which I think ought to be considered the muzzle or rostrum, as it is a continuation of the neck, over which a bridge is thrown, formed of the eyes and tentacula; and close under them, but on the upper part of the base, or hinder portion of the rostrum, is the proboscidal orifice, from which, though a circumstance of the rarest occurrence, I have in three species seen the evolution of that organ, in the *Chemnitzia pallida*, *C. acuta*, and *C. plicata*; the animals kept it exserted from half a minute to three minutes. Mr. Alder's figure in the 'Annals of Natural History,' N.S. vol. vii. p. 464, from a sketch of M. Lovèn, gives a very good representation of it; the remaining or terminal portion of the rostrum appears to be mute, and is for more or less of its length attached to the animal's foot; in other words, it is less free than the muzzle of the *Rissoæ*, of which I consider it the representative and remnant, and which, it will be seen, has entirely vanished in *Eulima*. Though authors speak of a mentum in that genus, I can find none; they have, I think, mistaken for it the upper margin or flap of the foot, which in front is divided by a narrow groove. This separation is more or less apparent in most, if not in all, spiral Gasteropoda; it has, however, little resemblance to the rostrum of the *Chemnitziæ*, which is a long, narrow, thick, distinct, and otherwise variable organ, proceeding from the neck as its continuation, and has much the aspect of a mute Rissoidean muzzle; whilst the margins of the foot of the *Eulimæ* and other Gasteropoda,

and they are generally present in the *Chemnitziæ*, are to assist flexibility on the march, in the same manner as the digitations of the feet of all animals assist progression. Lovèn, who has described the mentum in his genus *Turbonilla*—our *Chemnitzia*—has not, though he has described the animal of *Eulima*, mentioned the presence of a mentum or rostrum in that genus.

The point of issue of the proboscis, from the upper part of the rostrum, is more advanced and visible in *Chem. plicata* than in any other species I have yet examined; it was from this animal that it continued evolved more than three minutes, affording me a sight that falls to the lot of few malacologists. I believe I speak within compass, when I state, that I have examined more than a thousand live *Chemnitziæ* of twenty species, yet, except on the three occasions alluded to, I never witnessed its exsertion.

All the *Chemnitziæ* have a semitubular fold more or less developed in the mantle, which, though it issues at the upper angle of the aperture, close to the debouchure of the rejectamental orifice, appears more like a branchial one than for fæcal functions. In the *true C. acuta* it is largely exserted and *very* conspicuous. Can this fold be analogous to the process I have described at the same point in many of the *Rissoæ*? Can it have the double, though apparently incompatible, duties of depuration, and to supply the animal, when the operculum on certain exigencies is required to be nearly closed, with the branchial fluid?

The presence of a proboscis brings this genus very near to the Canalifera; but the *Eulimæ* are still nearer, as they have no head or rostrum, and the proboscis issues nearly at the fork between the tentacula, as in the Muricidal families.

The rostrum varies greatly in the proportions of its arcuations, scissions, and points of attachment to the foot; in the *Chem. unidentata* it is plain and truncate, in *C. acuta* it forms an open subcircular channel with a cochleariform termination, and in *Chem. conoidea* it is cloven nearly to the base, simulating a second pair of tentacula.

I have omitted to remark, that the orifice of the rostrum is

not precisely in the position of the proboscidal fissure of the *Muricidæ*; it is not quite so low in the fork, though exactly under the tentacula at the point of the invasion of the neck, and its continuation the rostrum, by those organs. This position is proved by the proboscis, when evolved, lying upon the rostrum, and by its breadth equalling that of the neck (a point I formerly doubted), and entirely hiding that organ from view. This leads me to say, that for the fourth time, a few days since, I witnessed the emission of the proboscis from a specimen of one of the slender varieties of *Chem. acuta*. I had an excellent view, as the animal exserted and withdrew it several times, which was not the case before; it was not quite so slender at the point, nor so much arcuated as in Mr. Alder's figure; its orifice was distinctly seen.

From the above remarks and the descriptions that follow, which comprise animals of the genera *Chemnitzia, Odostomia,* and *Eulimella* of modern authors, I submit to naturalists the propriety of merging the two latter in *Chemnitzia,* an appellation that fortunately has no other significancy than that of compliment to a laborious author in this branch of natural history. The similarity of the organs of the animals of the three genera, so far from affording essential generic characters, does not suffice without the assistance of the shell for specific distinction. Surely the *Chem. rufa* and *C. elegantissima* should not be separated from the smoother *Chem. Scillæ* and *C. acicula,* merely because the one is smooth and the other is ribbed: if so, to be consistent, it would be necessary to separate the smooth *Chem. pallida* from the ribbed *Chem. decussata* and *interstincta.* As to the spiral fold, all the *Chemnitziæ* have it, though in many it does not come into the limits of visibility; but is that a reason to separate precisely congeneric animals? The tooth or fold, according to the species, is as often absent from view in the aperture as present, and it is curious that this condition is not unfrequently seen in the *same species.* I would ask then, are the inhabitants of such shells to be consigned to *Chemnitzia* or *Odostomia*? *Chemnitzia,* even including the *Odostomiæ* and *Eulimellæ,* is not so abundant in species as to supply an excuse for dividing

them. I think that in the most numerous tribes, judicious grouping would be more scientific than the formation of effete genera.

It is necessary to offer a remark which is applicable to all the Mollusca, especially to the minute ones, and peculiarly so to the *Chemnitziæ*. Great care must be taken to distinguish between *bonâ fide* specialties, and those apparent ones brought on by an uneasy condition of the animal, which ought always to be described on the undisturbed march, when all the organs are naturally deployed, as at rest they are contracted; and violent exertion, which often arises when the animal in creeping arrives at the level of the water in the glass in which it is confined, or meets with an impediment, has the effect of producing unnatural forms: for example, the foot is often made to appear deeply emarginate or hollowed out by the excessive protrusion of the auricles, and the termination of the rostrum is in like manner distorted by the right and left points being exserted preternaturally; but all these forced positions vanish on the deliberate march. Inattention to these points has occasionally led me into errors, which will be noticed under their respective heads; I will not call them trifling, as perhaps on such the distinctness of a particular species might hinge.

In further explanation of the above remarks, it is proper to observe, that as regards the generic characters of the tentacula, we have only given the usual undisturbed aspect; but when the animal is disquieted, it effects, at will, various changes of shape of the lateral membranes, such as folding them longitudinally with a slight spiral tendency, or contorting them into an auriform figure. These phases, in quiet progression, in a great measure disappear, and the tentacula become smooth, triangular, pointed, bevelled, and symmetrical,—even the minute apical lobes vanish; these are, I believe, caused by the contraction of the skin by the tentacular muscle; they vary greatly in the different species; even in the same, the shape and position constantly fluctuate, being flat, globular, elongated, often appearing in a lateral point, sometimes precisely central, or changing from the absolute

termination to an antepenultimate one. I apprehend that these minute lobular appearances are due to the retractors of the tentacula concentrating at their tips a portion of the flake-white markings that are seen on those organs in all the *Chemnitziæ*, and have no functional attribute beyond what is common to all tentacula.

I have to add, in respect to the proboscis of *Chemnitzia*, that the organ is long, flattish, at least so in appearance, broad at the base, gradually tapering to its minute orifice; the terminal half in the *Ch. plicata* example is tinged with dull sulphur-yellow, like that of the body, neck, and rostrum. After the proboscis was fully protruded, in about a second, I saw, through the hyaline texture, another organ unroll itself from *base to point*, from which one would infer, that the inner cylinder, if it be one, is not fixed to the inside terminus of the outer tube; or it is possible that the organ I saw ascend from the base of the proboscis, might be the very long, flat, unarmed lingual riband.

With regard to what I term the rostrum, M. Lovèn says, "that the mentum has been misunderstood, and has generally been supposed to answer to the muzzle of *Turbo*, but that is not the case; this perfectly formed part is what I would call the mentum, the muscular mass, which is so extremely developed in *Natica*, covering part of the tentacula and mouth." With respect to this extract, I cannot concur. The mentum, which I call the rostrum in *Chemnitzia*, has very little analogy with the upper part of the foot in *Natica*, which I admit is always spread on the anterior part of the shell, as M. Lovèn observes; but then I cannot call the anterior portion of the foot a mentum. What M. Lovèn calls the mentum in *Chemnitzia*, is never spread on the upper part of the shell, and does not in any case touch it, and has no more connection with the foot than the muzzle of *Rissoa*; both are tied to the foot of their respective genera by a pedicle or bridle, which junction happens to be more anterior in *Chemnitzia* than in *Rissoa*, on which point see *Ch. elegantissima* and *Ch. pusilla*.

I must here remark, that the labium, which exists more or less conspicuously in every Gasteropod, is particularly deve-

loped at the anterior and upper part of the foot in most of the *Chemnitziæ*; it is a plain bilobed flap of the skin, separating the sole of the foot from the upper area, and has no connection with the so-called mentum. The rostrum, as I term it, is longer than the foot; but if it were an offspring thereof, one would suppose that such a condition could not exist; it, and its circular, bilobed, or spatulate disk, lie on the foot of the animal in full march, and, in every species I have examined, invariably precede it considerably. This is also the case with the muzzle of the *Rissoæ*. I speak confidently of the precession of the rostrum in *Chemnitzia*. This fact is very important, as it shows that this organ in that genus, and the muzzle of the *Littorinidæ*, are always carried on the march in a similar position, whereas in the *Muricidæ* the very short head, or anterior portion of the neck, is always borne posteriorly to the foot. For the reasons stated, I must consider the organ called the mentum as essentially distinct from the foot as the rostrum of the *Rissoæ*, fully justifying M. Philippi, M. D'Orbigny, and Mr. Lowe in stating, and, as I think, rightly describing it as "proboscis abbreviata, depressa, *infra* tentacula exserta." The rostrum, though mute anteally as an organ of deglutition, is nevertheless the remaining vestige of the Littorinidan lineage of this transition Muricidal animal. All the *Chemnitziæ* have the rostrum varying in shape in the different species.

The opercula of the *Chemnitziæ* are generally suboval or pyriform, and a compound of corneous and testaceous matter. They are all characterized by an apophysis, at about the centre of the inferior surface, nearest to the marginal notch for the tooth when there is one, and the nucleus shows its upper position. This process is usually more testaceous than the other portions of the operculum. The arrangement of the striæ shows some variations, but this is not uncommon in the same genus in other families, and may be seen even in the same species; for instance, in *Trochus lineatus* some have fine spiral striæ, so close-set as to appear concentric; some have radiating lines, and others are as grossly spiral as in the *Littorina littorea*. I have examined fourteen species, having, with great trouble,

cleansed them from every particle of dried animal matter, a difficult task from their minuteness; I have them on tablets, and shall be glad to show them to competent observers. They are interesting from the fact, that *Chemnitzia* and *Jeffreysia* are the only marine Gasteropodan genera that have these singular processes, except the *Barleeia rubra*, late the *Rissoa rubra*, which, from its apophysis and testaceous lid, has been shown above to be alien to *Rissoa*. The apophysis is nothing more than an extension, sometimes from the margin, but more usually, in *Chemnitzia*, springing from the under surface, and appears to act as a clamp to strengthen the closure of the operculum. This process is strikingly conspicuous in *Ch. conoidea* and *Ch. plicata*, much more so than in *Jeffreysia diaphana*; in *Ch. acuta* it approaches nearly to the two latter species, but is not quite so marginal; in *Ch. spiralis*, *Ch. decussata*, and *Ch. interstincta*, it scarcely varies from *Jeffreysia*.

The above generic diagnoses and peculiarities are absolutely alike in all the animals of our tribe of *Chemnitziæ, whatever may be the form of the shell*: how then can we, at this epoch of natural history, fall back upon exclusive and false conchological indices in the formation of our families and genera, such as, for example, the presence or absence of a tooth, the smooth or sculptured shell, and thus throw overboard the consideration of the soft parts and functional organs? Are variations of sculpture and a denticular point of almost inorganic matter to outvalue the peculiar external organs of the animal, as well as those internal ones which are the seat of the nerves and of vitality? If these positions are true, how can identical creatures be consigned to separate genera? Who will venture to draw a valid animal distinction between a *Chemnitzia* and an *Odostomia*? If this is impossible, this singular tribe, united by so many ties, ought not to form two divisions or genera. This is not my fiat; but nature, reason, and the fitness of things forbid so unnatural a disseverance.

We thus see that the Chemnitzian animal, by its head paraphernalia and œsophagean structure, is a compound one,

possessing the Muricidal retractile proboscis, as well as the rostrum of the Littorinidan race from whence it has proceeded. In the Mollusca, there is nothing extraordinary in this composite structure; we see it exemplified in the different plans of reproduction. All these circumstances point out the complexity and difficulty of the investigation of these singular animals; an hour or a day's examination is of little avail; they must be constantly studied for weeks, with a regular supply of fresh specimens, as torpidity always ensues in less than twenty-four hours; and they must not only be examined by day and sunlight, but also by the argand-lamp and wax-taper. We must literally attend, for these diminutive creatures, to the precept—

"Nocturnâ versate manu, versate diurnâ."

The observations on each species which have appeared in the 'Annals of Natural History' during the last three or four years will not be strictly amalgamated, but merely placed together to show the progress of science in new discoveries and rectifications, including the year 1854: every reader will easily cull from them the information he requires.

Before I enter on the descriptive notes, I present a few additional observations, and supply some omissions, on the peculiarities of the *Chemnitziæ*, in which I shall endeavour to dispel some of the clouds that still envelope this difficult and interesting group; and I shall also give a short *catalogue raisonné*, that is, a remark or two on every British *Chemnitzia*, whether genuine or apocryphal, sweeping away the phantoms of the genus, and thus establishing the means of identifying every genuine species; whereby the collector will be enabled to complete his list without fretting himself by endeavouring to obtain many recorded objects, which may as well be looked for as the philosopher's stone or perpetual motion. This review of the tribe, which I call *Chemnitziæ*, and others of the moderns partly *Chemnitziæ* and partly *Odostomiæ*, will, I think, interest and be singularly useful both to the malacologist and conchologist. In my *exposé* I shall show that this group, from its comparative difficulty and obscurity, has long

been the arena and one of the great laboratories of the species-manufacturers, who have turned them out with a liberal hand. This has in some measure been occasioned by the singular variations exhibited by the individuals of almost every species of the genus.

I here offer a correction. When I stated in the 'Annals of Natural History' that all the *Chemnitziæ* had a similar apophysis in the operculum to that assigned by Mr. Alder as one of the distinguishing characters of the genus *Jeffreysia*, I thought my discovery a new one; but I find by Dr. Johnston's excellent 'Introduction to Conchology,' from a paper inserted therein, written in 1835, by John Edward Gray, Esq., that that gentleman is the original discoverer of the flap or process in the opercula of the *Pyramidellidæ*. I now present a most important quotation from that portion of the paper relating to the opercula (p. 449); Mr. Gray says,—"The opercula of some shells which have plaits on their pillar are very thin, and are furnished with a moveable flap on the left side of their anterior margin, which passes over the plaits. I first observed this in the common *Tornatella*, and afterwards in *Turbo pallidus* of Montagu, the genus *Odostomia* of Dr. Fleming, and have since verified it in *Pyramidella*. The subannular operculum of *Turbinella cornigera* has a notch in the middle of the anterior margin and a plait running from the nucleus, but in this case the flap is not moveable."

The latter part of Mr. Gray's remarks with reference to the subannular operculum, the plait running from the nucleus, and the flap not being moveable, precisely embrace my views of *Jeffreysia diaphana*, in which the flap, as Mr. Gray calls it, is not moveable; and I found that to be the case in most of the fourteen species of *Chemnitziæ* I have examined; but in some, for instance the young shells of *Chem. pallida*, and in *Chem. rufa*, the flap or apophysis is moveable, or in other words, it is cartilaginous and flexible.

The aspect of the Chemnitzian animal is so peculiar and impressive, that when once it has been seen it will never be forgotten, and the malacologist will instantly detect an indi-

vidual of this genus from every other. These characters, allowing for specialty-variations, are essentially the same, whether the animal inhabits a shell of two or twenty volutions, whether they be tumid, rounded, flat, smooth or plicated, or coiled on a discoidal plane. In this genus, with two exceptions, we throw overboard form and markings, with respect to generic attributes, regarding all such points as only useful specialties. The first exception is the constant peculiarity in the form of the apex: this is never absent, though it is attended by numerous modifications of inversion, which, however slight they may be, always prognosticate that a shell with this character is inhabited by a true *Chemnitzia*. The second exception is the tooth or fold on the columella, which, when present, however variable in figure and position, I have always found to be an unerring indication that the animal is of Chemnitzian type; but as it is often absent, even in the same species, we have only its occasional assistance. With these views, we cannot see the utility of a divisional arrangement of the group; we can only acknowledge the genus *Chemnitzia* in its comprehensive integrity for the animal we have defined.

With respect to the apices, it is necessary to impress on the student, that in all the *Chemnitziæ* there are numerous phases of inflexion, from the most decided to the more obtusely-pointed or button-shaped subreflexions. The variations arise either from original configuration, or the forms become travestied from the effects of attrition, which will reduce the most conspicuous inverted points, of even good fresh specimens, to a button-shaped, sunken, or subreflected apex. Malacologists may not be aware that live shells, especially the littoral ones, are more liable to suffer from the attrition caused by the tides and waves than those of the deeper zones; and the true characters of their apices are with greater difficulty appreciated from being enveloped in calcareous and other extraneous deposits, the removal of which often destroys the true figure of the apex, and conchologists are thus misled. In many of the apices both of live and dead shells the coil is rubbed through, leaving a part which becomes worn, simu-

lating a button-shaped point, which may be, and is, often mistaken for that of a *Rissoa* by the incautious observer, leaving a greater or less portion of the other part of the coil soldered to the second volution; and microscopic aid is often required to detect these divisions of the terminal inflexions; but to the really observant and experienced malacologist, there is a certain aspect and peculiar twist at the antepenultimate bend of the inversion, which detects the true conchological Chemnitzian character. The only species we know of, in which any difficulty can arise by the subreflexion or bend on the second volution exhibiting a more subdued character of the apex, by being sunken or deposited in a groove or depression, with a more graduated arcuation, are the *Chemnitzia pallida, C. spiralis, C. nivosa,* Mont., and the *R. diaphana* of Mr. Alder—his *Jeff. diaphana*: not the *C. diaphana* of some authors, which is the young of *C. obliqua*—and perhaps there may be one or two more; all the remaining *Chemnitziæ* have their terminations unmistakeably inverted. We have examined and described all the animals, except that of *C. nivosa,* of the less inflexed species, and they are all decided *Chemnitziæ.*

With regard to the continuity and interruption of the peristome in *Chemnitzia,* I can say that neither character is to be depended on. I have in my cabinet elongated shells of this genus, and others of all its species with intensely continuous apertural margins—not mere testaceous deposits—which only simulate the continuity of the peristome; but as a general rule, the periphery of the aperture is more usually discontinuous; nevertheless the exceptions are numerous.

As to the characters of the umbilici, they are most fallacious; for instance, in the *Chemnitzia pallida,* and, in fact, in every species, there are individuals with every variation of the umbilicus, from the open and patulous to the mere fissure, and from it to the entirely imperforate one. To use the umbilicus at all is most deceptive; it can only be mentioned in the description of a particular individual. The fold or tooth, except its presence or non-presence, as a character, as we have stated above, is equally fallacious; for in the *same*

species it is often strong, slender, small, prominent and retired. Such characters cannot fail to mislead and confuse the young student.

The first and best characters of a *Chemnitzia* are undoubtedly the malacological ones we have given above, when they can be had; the next are of conchological value, the inflected apices; which however will almost always shadow out what the animal of a shell will prove; and the tooth, however minute and rudimental, is an excellent aid; and we may add, the flap or process of the operculum. All others, from their instability, lead to error and confusion; but if they are brought forward as specialties, it should be *sub modo*, with explanatory guards and limits, and indications of their variableness.

I now approach the *catalogue raisonné*, and will include with it the additions and new matter under the titles to which they belong. Perhaps it may be conceded that a sedulous examination of these interesting objects for more than forty years, has in some measure placed me in a position to offer a reformed list of the British *Chemnitziæ*, which will include all the animals, with our defined characters, whatever may be the form and sculpture of their testaceous habitations. To accomplish what I have proposed, my own cabinet affords large facilities, and my friend Mr. Barlee has kindly taken the great trouble to consign to me for inspection, from Falmouth, his rich tablets of accredited examples of those species I do not possess. These aids and appliances have increased my confidence that perhaps I may succeed in offering such a relieved and moderated list of the objects of this important genus, as will place within just limits the genuine indigenous *Chemnitziæ* of our Isles. We do not pretend to perform this task without error. Who, on such a subject, can avoid occasional misconceptions? We can only try conscientiously to perform our duty; but, alas! even in the midst of these delightful studies and recreations, the *bit of bitter* will spring up. How admirably has the inimitable Lucretius illustrated this inevitable ingredient in all human affairs, and told us that the attempt to evade the thorns of this destroyer of our peace is vain and fruitless!—

" Nequidquam : quoniam medio de fonte leporum
Surgit amari aliquid quod in ipsis floribus angat."

In this case the "amari aliquid" arises from my fear of imperilling old friendships, recollections and associations, which often afford the most delightful solaces, and soften down the rougher portions of our pilgrimage. I envy not the man who would not relax the sterner calls of duty to avoid disturbing these tranquillizing fountains of consolation. These reflections press heavily on me. I will simply obey the calls of duty. I am bound to do so, and will use the plainest phrases, consistent with the integrity of truth and honour, to bring me through the ordeal of my invidious task, which I would have gladly left to others.

It must be admitted that this interesting genus can no longer remain in its present unsatisfactory position; a reform must be carried out; the progress of malacological science demands that the rotten species be rooted out, to preserve the honest constituencies; the pruning-knife must be applied, to extirpate the gangrene that preys on the vitals of the genus:—

" Ense recidendum ne pars sincera trahatur."

It is enveloped in a darker mist of error and misapprehension than any other, springing partly from the difficulty of the subject, partly from defect of judgment and the unmeasured establishment of species on unsound bases. It may be asked, what will it avail to pluck a thorn from the mass—

" Quid te exempta juvat spinis de pluribus una?"

We answer, that if a unit of error is blotted out, good service is done; Sancho Panza tells us, "maille à maille fait l'haubergeon." Unless the proverb is acted on, all hope of reformation is vain, and error will become indefinitely persistent.

The following short remarks will prepare the way for the regular descriptions of the species.

The *Chemnitzia pallida* is so fully mentioned that we need only refer to it. The same may be said of the *Chem. rufa*. The *Chem. fulvocincta*, that has hitherto been confounded with

Chem. rufa, is acknowledged as a distinct species in the Appendix of the 'British Mollusca.' The *Chem. Sandvicensis*, the *dolioliformis*, nonnull., is an old, well-known, accredited species of Walker, Test. Min. Rar. We have observed it for the last forty years.

Nothing is more common than a littoral and coralline zone variety of the same species; these, from the effect of light, air, sun, habitat, and depth of water, are often so strongly marked as to induce conchologists to convert them into species, whereas, if they had examined the animal, they would have escaped the mortification of retractation.

Sometimes the littoral shell is the larger, and sometimes the coralline zone variety. The *C. truncatula* recently rediscovered by Mr. Barlee, at Plymouth, is large and elongated in the deeper zones; but the littoral variety, as with *C. pallida*, is dwarfish, more slender, and is called by recent authors *C. cylindrica*. They are undoubted varieties of each other, and both are the *Turbo nivosus* of Montagu; with me, *Chemnitzia nivosa*. As proof, the learned authors of the 'British Mollusca' have, on the highest authority, pronounced the *C. cylindrica* to be the "*nivosa*" of Montagu; it follows, that the *C. truncatula*, which, without question, is the adult of *C. cylindrica*, is also the "*nivosa*" of Montagu. A careful comparison of the opercula of the two has since fully confirmed this view.

These are the causes that have produced so many spurious species; we need only instance the *Chem. pallida* of Montagu, the parent of the following—*Odostomia eulimoides, O. rissoides, O. notata, O. albella, O. dubia, O. alba, O. nitida, O. glabrata*. The discovery of the animal of Mr. Alder's *Chem. obliqua* enables us to say, that the *Chem. diaphana* of authors is the young of that species. The *Chem. Warrenii*, called by some the *decorata* of Mr. Bean, is very distinct, both as to animal and shell, from the "*obliqua*"; and Montagu's *Chem. insculpta* is well distinguished from both, as our account of the animals of the three will show. With respect to Mr. Alder's *Chem. conspicua* and *C. striolata*, we have stated our opinion in the notes on *Chem. acuta*.

The *Chem. fenestrata* is very distinct, as is the elegant *C. scalaris*, which latter we have frequently, during the last thirty years, taken at Exmouth, varying in the number of ribs, but never in a living state. Since then, both have been taken alive, and, in the examinations, we have ascertained that the *Chem. rufescens* of the 'British Mollusca' is only a variety of the "*scalaris*." We have shown, in the descriptions of *Chem. interstincta* and *C. indistincta*, their specific points, and that the *Chem. clathrata* is scarcely a variety of the latter.

The elegant *C. decussata*, the "*arenaria*" of Montagu, abounds at the same place in the coralline zone, and with the well-known *C. Scillæ* and *C. acicula* require no remark, as they are undisputed species.

The *C. affinis* of authors, we believe, is a variety of the *C. acicula*, a very variable species in respect of the tumidity of the volutions and depth of the divisional lines, as well as of the texture of the shell. The *C. clavula* is very distinct, and everything relating to former impressions is fully explained under that title. We think the *Aclis nitidissima* of authors will, when the animal is observed, prove a *Chemnitzia*; the *Aclis unica*, formerly conjectured by me to be a *Chemnitzia*, has this year (1854) been discovered, and is described as *Rissoa unica*, in the elongated section of that genus.

The beautiful *Chemnitzia Gulsonæ* is our own discovery more than thirty years ago. I have not a character to add or omit from my original description in the Annals of Natural History, except that after the phrase of the specific character, "peripheria integra," *interdum interrupta* may be added, as my specimens differ. The apex is subreflexed—indeed every character denotes the Chemnitzian animal; there is not a single point of the *Rissoa* in it.

The *Chem. formosa* is a slender *Chem. rufa*.

The beautiful, but common, *Chem. elegantissima* is the staple commodity amongst the shells at Exmouth, where all its varieties occur, but never alive—probably because they inhabit the rocky portion of the laminarian zone, far beyond the lowest tides, where the dredge cannot work; they must

be alive in the immediate vicinity; their numbers, and often fresh and excellent condition, are sufficient proof; and we have offered what may be the solution of the difficulty of obtaining them alive *.

With respect to the so-called *Odostomia turrita* of authors, much discussion and difference of opinion have lately existed as to whether it is a distinct species, or a variety of an established one. It is inferred, from the specimens being more or less spirally striated throughout, that it is a good species. My own opinion has changed more than once: at one time I thought it might be an aberrant variety of *Chem. insculpta*; in this I am mistaken: again, I had made up my mind that it could not belong to *Chem. acuta*; in this point I am also mistaken, as it turns out to be scarcely a variety of that common species; it is one of the individuals with the more inflated volutions. I have forty specimens, which I took the trouble separately to submit to the microscope, and in those which were not worn, I was agreeably surprised to receive the solution of this problem, by finding that every recent shell was finely spirally striated throughout; in some the striæ were more apparent, and easily seen by a Coddington lens; in others the microscope was required, and with ordinary powers, even in the most apparently glabrous shells, the spiral lines became conspicuous. In the shells that have not been much rubbed, the striæ have acquired a crassitude by exposure to the air, as is always the case, which renders them more visible; I have such; but in the perfect recent ones they are excessively fine, and cannot be detected without considerable optical assistance. This is the simple history of the so-called *C. turrita*, which certainly is nothing more than the *Chem. acuta* with the striæ somewhat more apparent than usual; such are in our cabinet, and malacologists will find that they have not a perfect recent specimen of the *C. acuta* which is not more or less spirally striated throughout. This question may be considered finally settled. I have had the advantage

* Since this was written, *Chem. elegantissima* and the distinct *Chem. pusilla* have occurred alive in tolerable abundance; they are largely described.

of viewing Mr. Barlee's typical tablets of this variety of the *Chem. acuta*.

We need only say of the *C. plicata* and *C. unidentata*, that they are old Montaguan species; the two latter animals are described by us.

The *C. glabrata*? of Mühlfeldt, said to be a production of one of the isles of the Ultima Thule, is quite unknown to us*. The animals of the *C. acuta*, *C. conoidea*, and *C. spiralis* are fully mentioned; their shells are admitted as genuine indigena by every one. The *Chem. acuta* was discovered by us many years since at Exmouth, but at the time we neglected to publish notes on the hard parts; it is curious that after a lapse of thirty years we should be the first to rediscover and describe the animal.

The new *Chemnitzia Barleei*, as yet only known as a northern production, is the discovery of that excellent and indefatigable malacologist whose name it bears, and from specimens from himself has first been ushered into notice by ourselves as an undoubted member of this singularly difficult genus; and it affords, in the misconceptions that have attached to it, a plain proof of the correctness of this observation.

This species has been introduced and figured as the *Rissoa eximia*, and subsequently in the Appendix of the 'British Mollusca' as *Chem. eximia*. Surely the specific title of "*Barleei*," the discoverer, ought, *in this case*, to have precedence over even a prior one, applied erroneously.

After the reforms we have submitted, the British list will exhibit some attenuation; but a still numerous and a sounder family will testify the importance of this truly British group, which far outnumbers the discoveries of any other country in respect of this peculiar and very interesting genus. We think that the expurgation that has been made will bring the acquirement and identity of our indigenous species within the reach of the naturalist in this particular line of science.

* Since this remark we find that British representatives of this obscure species are only worn *C. pallida*.

The list will now stand thus:—

True species.

Chemnitzia pallida.	Chemnitzia Scillæ.	Chemnitzia decussata.
—— conoidea.	—— excavata.	—— rufa.
—— acuta.	—— Warrenii.	—— scalaris.
—— insculpta.	—— clavula.	—— elegantissima.
—— interstincta.	—— nivosa.	—— nitidissima.
—— Sandvicensis.	—— unidentata.	—— acicula.
—— fulvocincta.	—— plicata.	—— Barleei.
—— indistincta.	—— obliqua.	—— Gulsonæ.
—— fenestrata.	—— spiralis.	—— pusilla.

Of these, the animals of twenty-one have been examined, and seven still escape observation.

Spurious species.

Chem. formosa,	synonym of	Chemnitzia rufa.
C. clathrata,	—	C. indistincta.
C. conspicua?	—	C. acuta.
C. striolata?	—	C. acuta.
C. dubia,	—	C. pallida.
C. alba,	—	C. pallida.
C. nitida,	—	C. pallida.
C. albella,	—	C. pallida.
C. rissoides,	—	C. pallida.
C. eulimoides,	—	C. pallida.
C. cylindrica,	—	C. nivosa, dwarf and littoral.
C. truncatula,	—	C. nivosa, elongated var. of coralline zone.
C. decorata,	—	C. Warrenii.
C. diaphana,	—	C. obliqua, juv.
C. dolioliformis,	—	C. Sandvicensis.
C. notata,	—	C. pallida.
C. turrita,	—	C. acuta.
C. affinis,	—	C. acicula.
C. rufescens,	—	C. scalaris.
C. glabrata,	—	C. pallida.

CHEMNITZIA, D'Orbigny.

Odostomia, nonnull.

Animal spirale, rostro elongato præditum, sub basi tentaculorum proboscidem retractilem emittens. Tentacula brevia subtriangu-

laria basi coalita, lateribus membranaceis, apicibus lobis minutis, aut simulantibus, instructis. Oculi, ad basin centralem vel internam tentaculorum immersi. Pes characterem nullum constantem exhibens.

Testa spiralis, lævis, vel costata, vel lineis spirata, aut decussata, anfractibus tribus ad octodecim instructa; apertura ecanaliculata; latus columnare denticulo sæpe munitum, sæpe muticum. Apex, in gyrum sequentem reflexus. Operculum corneum, vel subtestaceum, subovale, striis ellipticis notatum, subspiratum, areâ inferiori sub nucleo, apophysi semper instructâ.

C. PALLIDA, Mont. certè.

Odostomia eulimoides, Brit. Moll. iii. p. 272, pl. 95. f. 1, 2, 3.
O. ? *pallida*, Brit. Moll. iii. p. 307, pl. 98. fig. 4, and iv. p. 274.
O. notata, *O. albella*, *O. dubia*, *O. alba*, *O. nitida*, *O. rissoides*, *O. eulimoides*, *O. glabrata*, auct. variorum*.
O. dubia, Brit. Moll. iii. p. 276, pl. 94. f. 8, and iv. p. 279.
O. alba, Brit. Moll. iii. p. 278, pl. 96. f. 9.
O. nitida, Brit. Moll. iii. p. 280, pl. 94. f. 6.
O. glabrata, Brit. Moll. iii. p. 283, pl. 98. f. 3.
O. rissoides, Brit. Moll. iii. p. 284, pl. 96. f. 4 (5, var. *albella*), and iv. p. 279.

Animal of six spiral turns; mantle plain. Foot short, truncate in front, slightly auricled, but not emarginate or hollowed out in the centre, as in its congener below, *Chemnitzia acuta*; rounded posteriorly, and terminating suddenly in a short point; it is powdered on its upper surface with pale gold-coloured minute points, and in some specimens with sulphur-yellow dots; beneath the same colours prevail, though less intensely: it has a light corneous, simple, not spiral, suboval operculum. The organ above the foot, and under the tentacula, termed by us the rostrum, and by others the mentum, is marked on each side with a pale yellow longitudinal line; on the quiet march it is short, thick, flat, slightly bevelled at the sides, truncate and dilated at the extremity; but when the animal is disturbed, it presents many phases of figure, which, without great care, may occasion discrepancies in the de-

* Figures of most of these varieties may be seen in that valuable *vade mecum*, the 'British Mollusca.'

scription of the same object: this remark is applicable to all the *Chemnitziæ*. The tentacula are short, flattened, triangular, not pointed, and bevelled like an awl, setaceous, and in some animals suffused with sulphur-yellow; each has also a longitudinal line running between the bevels; the eyes are at the internal points of the basally-coalescing tentacula, immersed in the skin. The operculigerous lobe is inconspicuous, almost obsolete, with scarcely a trace of lateral extensions.

In this species the minute branchial plume was found in the usual position, attached to the neck and mantle; no head-lappets, with scarcely the rudiments of a veil; the anal pellets were observed to be ejected from the right side; the male organe générateur was not seen. This species scarcely differs from *C. acuta*: the variation is in colour, and in the anterior part of the foot being less hollowed out.

There are five or six varieties slightly differing in contour. Their principal habitat is at the back of the auricles of the *Pecten opercularis* of the coralline zone, where they may be seen in clusters of six to ten, imbedded in animal mucus.

This is a very common species, and is, I think, undoubtedly Montagu's shell. I draw my conclusions from his figure and notes, in the 'Testacea Britannica,'—not from the fragment of what is said to be his type, that still exists, and is enveloped in dubiety, whether it be genuine, spurious, or a substitution by accident. When I stated in the December 'Annals' for 1850, in the memoir on the *Pyramidellidæ*, under the article *Chemnitzia eulimoides*, that that species, the very common *C. pallida* of authors, was not the "*pallida*" of Montagu, I did so, from having been led to believe that an undoubted type of his species existed to prove that fact; the 'British Mollusca' has since informed me that that is not the case; I therefore gladly revert to the commonly received opinion, which I had previously entertained, that the well-known *Chem. pallida* of almost all authors, or one of its innumerable varieties, is the true Montaguan "*pallida*." Montagu has stated his "*pallida*" to be very rare. When he wrote, the minuter species were procured by ocular labour from the littoral sands,

and as they were rarely washed up from the deeper and more distant zones, they were of course very scarce; but if the modern dredge or trawl-boat had been in general use, they would have been obtained in abundance.

We have numerous suites of the *C. pallida*, our type, of all adult sizes; of all juvenile ones; of all forms, slender, tumid, short, elongated; of every description of markings, smooth, rough, spirally ridged, or more finely striated, with the fold sometimes conspicuous, often scarcely visible, and an umbilicus of most variable character: all these phases of the same species may be seen in our cabinet, in which scarcely a specimen of the *C. pallida* can be matched, because all differ. What has been the result? Authors have produced their interminable lists of varieties; and when a somewhat more differential form was met with, it was promoted to a species. We have not the slightest doubt that the *Chemnitzia rissoides* is a dwarf littoral variety of the "*pallida*." A comparison of our notes on the two animals bears us out in this view; these two alone agree, whilst every other exhibits some difference. Besides, our examination of the opercula of this genus strongly supports their identity; they are amongst the few species that have the pillar-lip flap moveable, resulting from cartilaginous flexibility. This rissoidean variety of *Chem. pallida* is the parent of the *C. albella* and *C. dubia* of authors. We possess them both, besides having had authentic specimens sent to us by Mr. Barlee for inspection; the *C. alba* and *C. nitida*, from the figures in the 'British Mollusca,' and in other works, are, beyond doubt, of the same parentage. I engage to match any of the four species I have named. I conclude, from the 'British Mollusca,' that the *C. notata*, non-null. is a variety of the typical "*pallida*." Montagu's shell, from his figure, is also probably a semistriated "*pallida*;" one of the varieties with a retired inconspicuous fold, and a produced spire, smooth or polished by attrition. We have here a goodly progeny of, as I believe, six pseudo-species from a single parent: I must be allowed to insist on this position with respect to *C. pallida* and its spurious offspring. I think it cannot be subverted.

Having examined some of these so-called species, I am bound to add them to the synonymy of *Chemnitzia pallida*; one of the most variable species as regards the shell; but the animals of all these spurious articles have the unvarying distinguishing character of *C. pallida*, which is absent from all the other *Chemnitziæ* that can in any way be confounded with this group,—I mean the liberal, though irregular aspersion of many of their organs with minute sulphur-yellow or gold-coloured spots and points; and above all, the organs of their animals are similar. This species is an inhabitant of all the zones, and receives that impress as to form and size which results from the incidents of the respective localities; these causes have doubtless led to the formation of the pseudo-species, which I think only in some cases can claim even the distinction of varieties.

We add a few remarks on the variety of the *pallida* termed by some authors *rissoides*, and considered by them a distinct species. We do not concur in that opinion, as it has all the characteristics of the "*pallida*." This variety, like the type, varies greatly in size and contour; scarcely two specimens will be found congruous; every 100 yards of coast appears to possess its variety. It is a most ubiquitous animal, being taken in every kind of sea-bottom, mud, sand, shelly debris, and Nullipores; the products of the littoral grounds are usually of minor bulk, those of the muddy districts the largest.

Ch. plicata, Mont.

Turbo et *Odostomia plicata*, auctorum, et Brit. Moll. iii. p. 271, pl. 98. f. 1, 2.

The animal throughout is pale frosted-yellow, inhabiting a spiral shell of six or seven slightly raised volutions. Mantle simple. Rostrum short, flat, entire, slightly bevelled or pared off at some points of the superficies, gradually dilating to the terminus, which sometimes appears truncate, but often assumes the figure of a shallow, hollowed-out, subcircular disk. The tentacula are triangular, bevelled, broad, flat, rather longer than in its congeners of the same size, and terminate in

rounded sublanceolate points. The eyes are imbedded in the skin at the internal bases, but not quite so close together as in some other species. Foot short, truncate in front, slightly notched in the centre, labiated, rounded behind when at rest; somewhat elongated, though not much pointed, on the march; it carries the very light horn-coloured operculum of suboval form, with oblique striæ of growth, on a simple upper lobe advanced to nearly the junction of the foot with the body. The foot has an inconspicuous central longitudinal line on the sole.

It inhabits in sufficient abundance the littoral zone at Exmouth; we have often taken in one search 100 live specimens; it is, I believe, a strictly littoral species; those taken in the coralline district have turned out, on examination, slender young *Chemnitzia acuta*.

Ch. unidentata, Montagu.

Odostomia unidentata, Brit. Moll. iii. p. 264, pl. 95. f. 7, 8.

Animal spiral, bluish hyaline-white. Mantle even with the shell. Rostrum on the march extended beyond the foot, compressed, bevelled at the margin, entire, truncate in front, varying less in figure than its congeners. Tentacula short, broad, awl-shaped, setose, blunt, with a fine transparent line through their centres. The eyes are within the internal bases, close together, not raised, fixed on the connecting membrane. The foot is short, truncate, slightly eared, but not in the least emarginate in front as in *Chemnitzia acuta*, or even hollowed-out like that of *C. pallida*, rounded posteriorly, sloping to a broad, obtuse, lance-shaped terminus, and carries on the posterior upper surface of a scarcely perceptible operculigerous lobe, a light corneous, suboval, simply striated operculum. The anterior portion of the sole of the foot is flake-white, the posterior hyaline, with a fine longitudinal line only in the centre of that part. The sole of the foot is divided from the upper pedal disk by a shallow groove, giving the foot a labiated aspect.

This species differs little from *C. acuta*; the foot not being emarginate is the principal distinction, and the tentacula are

rather stronger and broader than in that species. Habitat amongst the masses of Annelida and other animals imbedded in old oyster-shells from the coralline zone.

Ch. acuta, mihi.

Ch. acuta, mihi, Ann. Nat. Hist. N. S. vi. p. 452.
Odostomia acuta, auct. et Brit. Moll. iii. p. 269, pl. 97. f. 8, 9.
O. conspicua, Alder ? et Brit. Moll. iii. p. 263, pl. 95. f. 6.
O. turrita, nonnull. No figure.
O. striolata, Alder ? et Brit. Moll. iii. p. 267, pl. 95. f. 5.

Animal inhabiting a glossy shell of 5–6 rounded volutions of a more or less pale livid red, pinkish, or pearly hue; the apex is greatly reflexed, and the aperture furnished with a conspicuous tooth. The ground colour of the animal is a sordid white, mixed with clouded pale yellow, red, or brown patches and points, which are irregularly distributed on many of the organs; the tissue of the skin is smooth, rarely frosted or breaking into a mottled flaky aspect. The mantle is even, except that at the upper angle of the aperture there is a very evident folded tubular canal, which I have alluded to in the preliminary observations on the genus. I will only add, Mr. Lowe writes, "pallio ecanaliculato;" M. Lovèn says, "processus pallii dexter canaliculatus;" from which it may be inferred, that the canal is sometimes present, at others not, or not visible. The rostrum is slender, deeply channeled, or hollowed-out its whole length, having a cochleariform termination, and at the upper surface of its base emits the proboscis. The tentacula are moderately long, divergent, subtriangular, bevelled, with the margins only slightly folded, and the tips are less white and inflated than usual; the eyes are rather close at the internal angles. Foot short, opake-white, often aspersed on both surfaces with the varying hues I have spoken of above, deeply hollowed-out in front, forming with the angles long auricles, which, when drawn together by the animal, have the appearance of a second pair of tentacula. Its posteal termination, at the will of the animal, assumes the varying phases of the pointed and obtuse forms, carrying at the junction of the foot with the body, on a simple emi-

nence, a pyriform red-brown or yellowish obliquely striated operculum.

There being some inaccuracies in my account of the *C. acuta* in the 'Annals' referred to above, I have reproduced it; as it is an important species embracing several others of doubtful parentage and some varieties, which latter produce the three following distinct forms. The slender subcylindrical variety passes in all collections for the coralline zone *C. plicata*; this is an error: an examination of the animal shows it to be a *C. acuta*, differing materially in its organs from the true "*plicata*," which is essentially a littoral animal, rarely, if ever, found beyond that limit: I have hundreds of examples taken alive. The next form is that of the common livid flesh or pearl-coloured glossy shell of 5–6 volutions, with a cone of broader basal dimensions. This is the type, and though usually smooth in the aperture, is sometimes furnished with transverse crenæ in the throat. I have four which were examined alive in comparison with the smooth ones, and they are, both in shell and animal, identical; it is difficult to account for the occasional presence of distinct crenæ in the same species. The third form is of the larger size of 6–8 volutions with white shells; these are smooth, though sometimes furnished with striæ in the throat of the aperture; I have several of each, which are so exactly represented by the figure of Mr. Alder's *O. conspicua* in the 'British Mollusca,' that I am induced to consider that species as a large crenated *C. acuta*; and it is not improbable that the *O. striolata* of the same author, like the *C. turrita*, may be a striated *C. acuta*, which are all more or less furnished with spiral striæ on the volutions. I must observe, that the crenated examples of *C. acuta* must not be confounded with any variety of *C. conoidea*, as the animals of the two are very different; and as regards the shell, the cone of the one attenuates suddenly, whilst in the *C. conoidea* it diminishes more gradually and tumidly.

The *C. acuta* is by far the most abundant *Chemnitzia* of the South Devon coasts, and is taken in the coralline and muddy shelly districts. Independent of the three principal

forms, each differs greatly in the contour and colour of its individuals; it is, after the *C. pallida*, the most variable of the *Chemnitziæ*.

Ch. conoidea, Brocchi.

Odostomia conoidea, Brit. Moll. iii. p. 260, pl. 95. f. 4.

Animal inhabiting a spiral shell of eight volutions, hyaline bluish-white throughout, slightly shot with flake-white cloudy matter; mantle plain. Rostrum deeply emarginate, forming two minute leaves turning to the right and left, with a narrow depressed line dividing them in the centre, as far as the eyes; they almost represent a second pair of tentacula. Proboscidal orifice at the termination of the groove close under the eyes. In some specimens the scission of the rostrum nearly extends to the eyes. The true tentacula are subtriangular, flat, bevelled, not very short, rounded at the tips, slightly setose. The eyes are very black, situated exactly at the internal bases of the tentacula immersed in the skin, and so close to each other that a hair can scarcely be laid between them: I never saw the eyes so contiguous in any other mollusk. Foot large, rather long, membranous, gently reflected at the sides on itself, which reflexion it in some measure retains on the march, deeply arcuated in front, causing the auricles to be pointed, and gradually tapering to a subtriangular termination. The usual operculum of the tribe is carried on a simple lobe in an advanced position nearly at the junction of the foot with the body. The animal is vivacious, displays the eyes on the march, and makes rapid progression; it is only obtained at Exmouth in the coralline zone, and is rare.

A splendid series of all sizes of this beautiful species has been examined, and I have little more to observe, except that I find it has a slender and tumid variety.

Ch. rufa, Philippi.

Ch. rufa, Brit. Moll. iii. p. 245, pl. 93. f. 3.
Ch. formosa, Brit. Moll. iii. p. 248, pl. 93. f. 5, and iv. p. 274.

Animal inhabiting a shell of fourteen flat plicated volutions

with interstitial short transverse lines; the general aspect as to colour is pale azure-hyaline, irregularly aspersed with snow-coloured opake flakes. The rostrum proceeds from the coalescing tentacular membrane, forming a sort of head-veil to a little beyond the foot; it is long, flat, and terminates in two arcuated lobes with a wide central indentation between them; the proboscidal orifice is not quite at the extremity of the rostrum, but is placed on its upper surface. The tentacular veil, originating in the basal coalition of those organs, is entire, and diverges into two very short, flat, broad, bevelled, subtriangular tentaculiform processes rounded on the tips, on each of which there are about nine intense-white subcircular minute flakes. The eyes are not on the triangular bases of the tentacula, but a little posterior to their origin, imbedded in the skin of the anterior base of the neck exactly behind them; that is, it can scarcely be appreciated if the inclination be external or internal. The foot is large, moderately long, auricled in front, bevelled to a very fine edge, and when in the full extension of march tapers to a point, when at rest it is rounded; it is flat, of thin texture, of a pale blue-hyaline colour, suffused with opake snow-white matter; it carries on a simple, scarcely raised operculigerous lobe, situate quite at the middle, or at the junction of the pedicle of the foot with the body, an oblong-oval light corneous operculum, with a depressed point as a nucleus, from which oblique striæ of increment proceed. The branchiæ, buccal apparatus, and the organs of reproduction were not seen, as the shells could not be destroyed, and it is probable that their minuteness would have caused any attempt to detect them to end in failure.

There is no tooth on the columella of this species, as in most of the preceding ones, but there are sometimes within the aperture of the ultimate volution one or two minute denticles, as in *Conovulus denticulatus*, and we have the *C. acicula* with a decided pillar fold. These columellar appendages cannot at all be depended on from their instability and variableness; they may serve as a kind of mark to distinguish one species from another conchologically, but even that

index fails when the species is sometimes with and sometimes without the denticle.

This is a rare animal on the Devon coasts, but we have taken several at Exmouth in the coralline zone; it is by no means shy, marching with vivacity, and allowing a good examination.

Addendum. — The tentacular veil, or, in other words, the bases of the short, broad, leaf-like tentacula, are not entire, as stated above, but slightly emarginate in the centre, just dividing the leaves, and with a groove in continuation of the central indentation of the rostrum.

The animal of this species is the southern variety mentioned by the learned authors of the 'British Mollusca,' vol. iii. p. 245, which is certainly the true *C. rufa* of Philippi and authors. Professor Forbes and Mr. Hanley, in their account of the "*rufa*," have stated, that it is with some hesitation they have followed the suggestions of their friends: and well they might pause, as they have described an entirely distinct species, a northern one, the *Chemnitzia fulvocincta* of Thompson and Alder, for the true *rufa*, which we found thirty years ago at Exmouth, and of which we took five in 1850. The description of the animal in the 'British Mollusca' refers to the *C. fulvocincta*, and appears to differ from ours of the true "*rufa*" in those slight specialties which might be expected in such congeneric creatures: it is really extraordinary how two species so totally different, as to the hard parts, should have been confounded. I will now state the distinguishing characters of each.

The *C. fulvocincta* is well figured in the 'British Mollusca,' under the title of *C. rufa*; it is more conical and tapers more rapidly than the true *C. rufa*; it has rarely more than eleven or twelve volutions, and sixteen to eighteen ribs, somewhat raised and sinuated; each volution slopes from its base to the ascending suture, which is merely a fine line; it is very glossy, with a most conspicuous yellow or orange band spirally coasting the last five or six turns; the basal portion of the aperture is subrotund.

The genuine *C. rufa* is generally larger, though it has some

very slender varieties, one of which is figured in the 'British Mollusca,' under the appellation of *C. formosa*, which most accurately represents our true Exmouth shells of the "*rufa*," in which, in perfect specimens, there are often fourteen volutions and twenty ribs on the body; they are plain, straight, and not raised; the suture, instead of a fine line, is decidedly grooved; the interstitial striæ are adequately developed; the basal periphery of the aperture is usually less rounded and more subquadrangular, and the base of the body-whorl exhibits greater tumidity than in the *C. fulvocincta*. Our beautiful and perfect specimens are not glabrous; on the contrary, they show a palish dull rufous colour, with not a trace of the conspicuous tawny-orange spiral fascia of its congener: in fact, the true "*rufa*" differs in every point from the "*fulvocincta*." This comparison obliges me, with every deference, to submit, that for the *Chemnitzia rufa* of the authors of the 'British Mollusca,' the *C. fulvocincta* be substituted, and the southern shell they have alluded to, be named *C. rufa*, as it and the Exmouth examples truly represent that species; of which their *C. formosa* is a slender variety and synonym; indeed its figure excellently represents the "*rufa*."

The *C. rufescens* is decidedly distinct from either the "*rufa*" or "*fulvocincta*."

Ch. fulvocincta, Thompson and Alder.

Ch. fulvocincta, Brit. Moll. iv. p. 276, pl. 93. f. 4 (not fig. 3); (animal) pl. F.F. f. 4, as *rufa*.

See the notes above for what is known of this species.

Ch. spiralis, Mont.

Odostomia spiralis, Brit. Moll. iii. p. 299, pl. 97. f. 2; (animal) pl. F. F. f. 8, 9.
Turbo spiralis, Mont.

Animal occupying a spiral shell of four flat volutions. Mantle even. The colour in all parts is hyaline-white, delicately suffused with snow-white points of several magnitudes. The rostrum is moderately long, entire, flat, plain, rounded in

front; it issues from the tentacular membrane, and is placed between it and the foot, and is of greater length; on the march it is carried in advance of the foot, but the tentacula always reach beyond the rostrum, which only very rarely, by an extraordinary exertion, is extended to the tentacula: I mention this because I have seen the animal figured with the rostrum as long as the tentacula, which is an unusual position. The tentacula occupy the extent of the membrane from which they originate, coalescing at their bases, and diverging greatly to their points; they are short, flat, broad, bevelled, triangular, blunt, setose, with a snow-white line from base to point, and a round intense flake-white dot at their tips, which give them the aspect of being clavate; the eyes are large, black, placed on the skin at the internal bases of the tentacular bifurcation, beneath which is the proboscidal orifice. The foot is slightly auricled, and sinuated on each side so as to make a gradual central indentation; it is rather broad, perfectly round posteally at half extension, but in full march it tapers to a moderately pointed lanceolate termination, carrying on a plain upper lobe a suboval, light corneous, finely striated, simple operculum.

The animal is active, and shows its peculiarities *sans façon*. It inhabits at Exmouth the coralline, laminarian, and the lowest littoral levels. It scarcely differs from *C. rissoides*, except in being white instead of speckled with yellow, and in the foot being sinuated in front instead of truncate. There is usually a fold on the pillar.

Ch. interstincta, Mont.

Odostomia interstincta, Brit. Moll. iii. p. 296, pl. 97. f. 1.

Animal inhabiting a closely plicated white shell of five and a half flattish volutions, the body not being half the length of the shell; the apex is less reflexed than usual; the aperture has generally a visible tooth, and there are one or two rows of crenæ or lattice-work on the base, between the ribs, of the three lower volutions. The general colour of the animal, as regards the portion contained in the body whorl, is a frosted,

rather opake white. The mantle is even with the shell, scarcely showing a fold at the upper angle of the aperture. The rostrum is very slender, not cloven, but truncate at the end, and, as usual, on the march precedes the foot. The tentacula are rather long, slender, not particularly divergent, and have but narrow margins for the auriform folds; they are taper, bevelled, and terminate in prominent white tips; the eyes are not very close together at the internal bases. Foot short, narrowish, rarely extending when fully deployed much beyond the body volution, truncate in front or very little concave, with short auricles, and a little contracted below them, carrying on a simple upper lobe, at the junction of the foot with the body, a thin, pear-shaped, light corneous, obliquely striated operculum; the foot has a rather obtuse, though lanceolate, termination.

I have reproduced this species, partly with the view of correcting some slight errors, but principally to place it in immediate view, for comparison with its tumid variety, and with the next species, the *Chemnitzia indistincta*, and its variety that has been named *C. clathrata*, all of which have been strangely jumbled together; but very large series of both species and their varieties have, I think, enabled me to unravel various misapprehensions. With respect to the shell of the present species, it has only one well-marked tumid variety, which, as regards the animal, differs in no respect from its chief, as the posterior volutions of both, in the shell, are of a dark lead-colour; but the variety is invariably of larger size; the whorls, though the same in number, are more tumid, and the body volution is more than half the whole length of the shell; there is rarely on the body and next turn more than one well-pronounced row of crenæ, and a tooth is always visible in the aperture. I have a fine series of more than twenty examples of the variety, and 100 of the type, all of which have been examined alive.

It is difficult to say whether Montagu's figure represents the shell with the flat or tumid volutions, but as far as the indifferent engraving will allow one to judge, I should guess it to be the tumid variety. I believe, however, all collectors

consider the flatter shell the type, it being by far the most abundant. As I find the animals of both absolutely identical, I cannot hesitate to consider the differences of figure as of mere varietal value. The true *C. interstincta* has usually a fold in the aperture, but it is not uncommon without it, and these exceptions are multiplied in most collections by an admixture of some half-grown typical *indistincta* and the variety "*clathrata*," which are invariably without the tooth; it never exceeds $5\frac{1}{2}$ volutions.

The type is very common in the coralline district, but the tumid variety is oftener met with in shelly mud.

Ch. indistincta, Mont.

Ch. indistincta, Brit. Moll. iii. p. 255, pl. 94. f. 2, 3; and iv. pp. 274, 277, 278.

Ch. clathrata, Brit. Moll. iii. p. 258, pl. 94. f. 4; and iv. pp. 274, 277.

The animal inhabits a white sub-opake shell of six or seven, sometimes eight, rounded volutions, with close-set waved longitudinal plicæ that have 3–5 rows of short lines forming a lattice-work between the ribs, sometimes upon them at the bases of the last three or four whorls; the body is not nearly half the length of the entire shell; the aperture is always destitute of a tooth. The animal in the body-volution is pale yellowish subhyaline white, aspersed with minute snow flakes, but the posterior volutions are dark lead-colour, visible through the shell. When the neck is greatly protruded, two parallel longitudinal lines are seen, forming an open canal, perhaps for branchial purposes. The rostrum is long, rather narrow, and just rounded at the termination. The tentacula are very short, united at the bases, with their thin margins unfurled on the march, which gives them, instead of the usual auriform figure, a very large, subtriangular, broad, leafy aspect; they terminate in large inflated white tips, and are often delicately powdered with a pale, thin, cloud-like suffusion of excessively minute lemon-coloured points; the eyes are very black, distinct, and close together at the internal bases. The foot is large, thin, subhyaline, either truncate or concave in front, dependent on the will of the animal, with

very large auricles, which in progression are used as feelers; the margins of the foot are often reflexed, as if to embrace the sides of the shell; it is long, and when fully extended reaches to the third basal volution, and ends in a needle point; sometimes on each side there is a row of small flake-white spots; it carries on a simple upper lobe, scarcely distinguishable from the mass of the foot, a light corneous, thin, obliquely striated pyriform operculum.

The animal marches with rapidity, and is far more active than the *C. interstincta*. It inhabits, with the variety "*clathrata*," a peculiar district of shelly mud, between the laminarian and coralline zones in ten fathoms water, off Teignmouth.

That this is Montagu's *Turbo indistinctus* is scarcely doubtful; he says that his examples have six volutions, and no fold in the aperture—that is the number of the ordinary run of specimens; but both the type and variety, when very fine, have $6\frac{1}{2}$ to 8 turns, as our magnificent series will show.

There can be no doubt of the *C. indistincta* being distinct from the *C. interstincta*; we, in our first accounts, thought otherwise; but the greater number of volutions, the invariable absence of a tooth, the much more diffused lattice-work of the former, and the specific differences of the animals, afford decisive marks of distinction.

We have examined more than twenty live specimens of the typical species, in comparison, often in the same vase, with forty of the variety "*clathrata*," which only differs from the type, as regards the animal, in having the posterior volutions pale pink, giving the shell the appearance of being of a still paler pink hue, but in fresh shells the colour is a dull pearly white: this difference in the animals is probably dependent on food. Another variation, perhaps the effect of the same cause, is, that the contour of the variety is somewhat less slender than the type; but the similar number of the volutions, the character of the lattice-work, and the want of the tooth in the aperture of both, together with the apparent identity of the animals, forbid the differences I have noticed to be considered of more value than of mere and not uncommon variations.

Ch. Sandvicensis, nobis et Walker, Test. Min. Rar.

Odostomia dolioliformis, Brit. Moll. iii. p. 301, pl. 97. f. 5; and iv. p. 281.

——— ———, Jeffreys.

Testa subovalis, inflata, subpellucida, pruinosa, anfractibus quatuor, duobus ultimis tumidis, superne turriculatis, lineis flexuosis, spiraliter cinctis, striis incrementi prominulis, densis, obliquis, decussatis; anfractu basali, plusquam dimidiam testæ superante. Apex in gyrum sequentem reflexus. Apertura subovalis, ad basin rotundata, effusa, supra in brevem rectangulum desinens. Labium columnare reflexum, incrassatum, umbilicum angustum obtegens, superne plicam conspicuam gerens. Margo externa simplex. Axis circa $\frac{1}{13}$, diameter $\frac{1}{18}$ unciæ.

Exmouth, August 1850.

I have just obtained fine specimens of this rare species, first discovered by Mr. Walker at Sandwich, and rediscovered by myself at Exmouth nearly thirty years ago. From an examination of my present acquisitions at this place, I am bound, in justice to that naturalist's diagnosis, to confirm the statement that his shell has a *quasi*-reticulated aspect, resulting from the close-set raised lines of increment, crossing the spiral striæ, though irregularly. Mr. Walker's phrase of "elegantly reticulated" is not borne out, nor is the shell pellucid, but sub-opake and frosted; its texture and colour somewhat resemble the *Bullæa pruinosa*. Some of the recent specimens were taken alive; but unfortunately, before they were detected, the animals had become asphyxied beyond resuscitation by immersion in their natural element. Notwithstanding these discrepancies in Mr. Walker's and my specific characters, I have scarcely a doubt of this being the species he meant to designate, making due allowances for the lax and less precise descriptions of his day. For instance, he says, the shell has three volutions;—a cursory view would assign it that number; but the conchologists of that period, with the exception of the accurate Montagu, were not aware that the apical turns in a certain tribe of the minuter species were reflexed on the subsequent one. Mr. Walker's specific characters are perhaps insufficient for positive identification. At the time of the re-

discovery of the species I neglected to enlarge them; I have now repaired the omission, by presenting above more correct diagnoses. Believing our shell to be the true *Turbo Sandvicensis*, I of course adopt, as a matter of right and justice, Mr. Walker's specific appellation. I think no other shell will ever be found to represent Mr. Walker's object.

Since the above was written, we have had the good fortune to capture several lively animals.

Animal inhabiting a white spirally striated subglobose shell of four volutions, with a reflexed apex and strong fold on the pillar. The colour throughout is hyaline pale azure. Mantle even with the apertural margin, except a slight canaliculation at the upper angle of the right side. The rostrum, which some call the mentum, is of the exact characteristic essential shape of the tribe; in quietude it scarcely extends to the anterior margin of the foot, but on the march it considerably precedes that organ. The tentacula are proportionately longer than in its congeners, not so triangular, nor furnished with such broad lateral membranes, nor do they coalesce so decidedly as in some species to form a veil; nevertheless they are bevelled and subtriangular, with the eyes at the internal bases. The tip of each tentaculum has a point of flake-white, giving, I think, only the appearance of a slight inflation; or it may be real for a limited period, caused by the contraction of the muscle of the tentaculum.

The foot is a singular deviation from that organ in the typical species; it is short, broad and blunt, truncate anteriorly, there often twisting itself into acute angles, which, when they happen to fall in a line with the true tentacula, give the appearance of a pair on each side, but a change of position instantly makes that appearance disappear; the anterior third portion of the foot is somewhat contracted; at this point a transverse groove appears, from the centre of which another longitudinal one proceeds to the posterior end, dividing the foot below the transverse portion into two suboval lobes, each rounded at its termination and separated by an emargination: whether these grooves are only depressions or solutions of continuity, I could not in so minute a creature satis-

factorily determine; but they give the foot the appearance of being formed of three lobes, an anterior and two suboval lateral ones with rounded termini. This is the great singularity, and malacologists would constitute a genus for it, but in all the essential points it is a decided and typical *Chemnitzia*. The operculum is fixed on a plain, not extended lobe; it has the flap-process or apophysis of the tribe, not in the same plane, but inflexed at right angles; it is cartilaginous and flexible in this species, and the striæ of increment range in elliptical curves, as in the typical *Chemnitzia pallida*.

The animal is not lively, at least the only one I have examined was not so; and it is possible more active creatures, which are exceedingly rare, may cause some modification of the points described. It inhabits the littoral zone, and is unrecorded. Axis $\frac{1}{15}$, diameter $\frac{1}{18}$ unciæ.

A second example has shown, that the transverse groove in the foot does not exist, and that in the first specimen it was due to contraction, which when it is completely developed disappears; nevertheless the structure is peculiar: at rest it is sub-oval, but divided into two portions by an apparent superficial line due to colour; when fully deployed, the anterior one is constricted, slender, attenuated, capable of great extension, slightly auricled and emarginate, subhyaline white; the posterior portion is sub-oval, short, broad, fleshy, of an opake pale drab, divided by a deep medial longitudinal fissure, that seems almost to separate the integuments into two lobes, forming together a rounded termination with a narrow central emargination.

Ch. decussata, Montagu.

Odostomia decussata, Brit. Moll. iii. p. 303, pl. 97. f. 6, 7; and iv. p. 281.

Animal inhabiting a pale drab spiral decussated shell of 4–5 volutions; it is hyaline white, except the proboscidal muzzle, that passes for the mentum with some malacologists, which is pale pink or red. The mantle is even. The rostrum of this species is less lobed and more truncate than in its congeners, but it has at times varying phases; it is small, sub-

cylindrical and narrow, and on the march, as is the invariable practice in all the species, it is in advance of the anterior portion of the foot, which, like the terminus of the rostrum, is truncate and without the auricular points at the angles; it is rather broad, and when extended reaches halfway on the antepenultimate volution, posteriorly becoming a little constricted, and having a very rounded termination. The tentacula are triangular, bevelled laterally, pointed, with the usual two minute flake-white lobes at the tips, which may be partly real, but principally simulations that depend on the will of the animal; the lateral membranes, which are not so extensive as in some species, coalesce and form a shallow veil; the eyes are very close together exactly at the internal bases, not immersed, but a little elevated on minute prominences. We may remark, that in this tribe the membranes on both sides of each tentaculum simulate all kinds of shapes and foldings, which have been termed auriform or subtubular; these are deceptions, and due to the will of the animal, as on the march the tentacula are always carried in a regular, smooth, triangular, bevelled position. These changes from one form to another only occur when the animal is disquieted; they are then frequently and suddenly made, and the tentacles as quickly assume a natural form. The operculum is of a narrow, rather elongated, oval shape, carried on a simple lobe at some little distance from the posterior terminus of the foot; it has the usual, characteristic, right-angled, semi-cartilaginous, minute, notched apophysis and oblique striæ of the tribe.

The animal is not at all shy, progresses rapidly, and inhabits the coralline zone at Budleigh Salterton, where we have taken it in 12 fathoms water, more than once, alive. The animal has not before been described.

Ch. elegantissima, Mont.

Ch. elegantissima, Brit. Moll. iii. p. 242, pl. 93. f. 1, 2; and iv. p. 275.

Animal inhabiting a white, spiral, elongated, glabrous shell of 12–16 costated volutions; it is, except the eyes, hyaline-white throughout. The produced rostrum is deeply grooved in the middle on the upper surface, and imperforate at the

termination; there is at its clavate extremity a vertical, and a little below, a linear, transverse, deeply-impressed line, both having the appearance of a breach of continuity, though perhaps not really so. I mention these circumstances in this species to excite attention, as they are more developed than in such of its congeners as I have examined. The rostrum is conspicuously carried before the foot on the march, when it appears truncate, but at rest is rounded and sinuated as in *C. pallida*. The foot is also truncate, very slightly auricled; the upper flap-skin, or real mentum, does not reach to its margin; it is narrow, not very long, attenuated and tapering to a rounded broad extremity, carrying at a short distance therefrom, on an obsolete lobe, a narrowish, pear-shaped, obliquely-striated, corneous operculum with a subelastic, rectangular apophysis, not notched in the centre, as the fold or denticle in this species is not usually visible; but in those examples where it is more or less pronounced, the notch is proportionately marked. The tentacula are short, triangular and pointed, having large lateral membranes which coalesce to half their altitude, and are capable of assuming various shapes, as the auriform, the semitubular, &c., and of forming longitudinal folds on the stamens; being again, as if by magic, returned to a smooth, pointed, correctly bevelled, unfolded, symmetrical condition, coalescing regularly at the bases; all these phases are effected by the will of the animal; in short, the tentacula in this creature have an arcuated, leaf-like, broadly-subtriangular aspect, scarcely showing inflations at the obtuse tips; the eyes are at a little distance from the internal line of the bases.

This elongated animal of sixteen volutions differs in no essential point, and scarcely in specialties, from its pigmy congeners of three turns, whether they be smooth, costated, toothed, or edentular; emphatically showing a generic division of the family to be impossible, on reasonable grounds: all the species must, I think, range as *Chemnitziæ*. The mantle is even, plain, scarcely having a trace of branchial canaliculation.

The *Ch. elegantissima* is never marked with purple streaks

like *Ch. pusilla*, and the tentacula are carried more in a line with the body than in that species; the shell is also more taper and of a more opake, sordid texture, but recent examples must be compared to see the value of this distinction.

This is the first year I have succeeded in obtaining live examples, which occurred in the littoral zone off Budleigh Salterton, where in former years I have taken abundance of fresh, excellent shells, but always without the inhabitant. The existing malacological notes on this animal are so meagre, that the present account may almost be considered as that of an unrecorded creature.

Ch. pusilla, Philippi.

Ch. elegantissima, var. *pusilla*, Anglorum, et Brit. Moll. iii. p. 243, and iv. p. 275.

A single live specimen of this very distinct species has occurred, which enables me, more decisively than any of its congeners, to insist on the position, that the eyes and tentacula are planted across the rostrum, which is an undoubted continuation of the neck. What has led to the idea that the so-called mentum belongs to the foot, is, that the pedal union with the general body of the animal is in this tribe a little more anteally advanced than in the *Rissoæ* of similar proportions, thus giving the neck, and its sequence the rostrum, an apparent connection with the foot, which, if organically viewed, it does not really possess.

It will only be necessary to notice the variations of the *C. pusilla* from its more stately congener the *C. elegantissima*. It is, as respects the shell, not half the size, is much more tumid, and does not taper in the decided manner of an example of that species of similar size. The variations of the malacology are more pronounced: the foot is much longer, extending on the march to the third basal volution, and terminating in almost a needle point; whilst in the other, in a similar condition, it is quite rounded, and does not reach beyond the body-whorl. In the "*pusilla*," the tentacula when spread have the membranes united almost to the extremities, which are minute and pointed, so that they appear in action as a single

united leaf; in its congener they are more triangular, less, though greatly, membranous, do not unite above half their length, and have very obtuse terminations. The *C. pusilla* has a palish purple streak on each tentaculum and on each side the rostrum; this fact is not without its value, as it proves pretty clearly that the rostrum belongs to the neck and tentacula, and not to the foot: in the *C. elegantissima* both the same parts are hyaline-white. They both inhabit the same littoral levels at Littleham Cove, Exmouth.

The addendum to the preceding species will apply to this; I have only to observe, that the constant variations in the colour, contour, and texture of the shells have been verified by the examination of nearly twenty live individuals of this species.

Ch. clavula, Lovèn ?

Eulimella clavula, Brit. Moll. iii. p. 314, pl. 98. f. 8; and iv. p. 283.

The animal inhabits a pearly-white, but not glossy shell of five rather rounded volutions, including the moderately reflexed apex. The body-whorl is about half the entire length of the shell, with a narrowish, elongated, oval aperture, quite free from angularity. The animal is clear frosted-white. Rostrum very narrow, rounded at the end, not bilobed nor grooved, and carried just before the foot; neck greatly protruded, showing, on the march, an open canal formed of two parallel longitudinal lines. Mantle even: no fold visible. Tentacula short, broad, swelling out behind like a minute wide leaf; the auriform folding nearly disappears on the march; they are not divergent; indeed, I may say, they are borne so close and straight as almost to hide the rostrum and proboscidal fissure; they may be termed small, short, triangular, and terminate each with two white inflations, that is, one completely apical, the other close below it quite lateral, subsemicircular, and as if soldered to the external sides of the points. I do not recollect having before observed this tentacular peculiarity. The eyes are at the internal bases, not very close together. The foot is a very deceptive organ, from its quality of exhibiting different appearances; it is very little concave in front, and has long

tentacular auricles; the margins are thin, often reflexed upwards towards the shell, and it posteally assumes a form varying from the needle point to an obtuse termination, carrying on a simple lobular eminence of the main foot, at its junction with the body, a minute, delicate, pearl-coloured, obliquely-striated operculum. The animal is very active and free. Taken with the *C. acicula* in the same locality. The animal of this species has hitherto escaped observation.

I stated in the 7th vol. of the 'Annals of Natural History,' N. S. p. 391, that I considered the *C. clavula* a variety of *C. acicula*, and confidently predicted that no animal would ever be discovered of such variety which would exhibit decided specialties. I believe this error has originated from having had varieties of the *C. acicula* sent me for examination instead of the true '*clavula*.' I apprehend this must have been the case, as no one with the true shells can confound the two. Whether I am right or wrong in this conjecture, the acquisition of eight living examples of the *C. clavula* proves, that as regards both the shell and animal it is very distinct from *C. acicula*.

Ch. Warrenii, Thompson.

Odostomia Warrenii, Brit. Moll. iii. p. 292, pl. 96. f. 2, 3; and iv. p. 280.
Chemnitzia decorata, nonnull.

Animal inhabiting a white subturreted shell of four compressed volutions, with oblique sutures; the basal part of the body-whorl being finely, superficially, and irregularly spirally striated. The mantle is even with the shell, but has the power of relaxing itself so as to produce a small conduit at the upper angle of the aperture. The rostrum is short, cloven as far as the eyes, having the segments curved to the right and left. The tentacula are short, triangular, bevelled, not broad, tapering to a fine point, and armed with small white inflated tips; they are carried in front of the head with an angular divergence of about 75°; the eyes are close together at the united internal bases. The foot is short, concave in front, slightly auricled, posteally terminating obtusely, with

a light, horny, thin, obliquely-striated operculum, seated on a simple lobe that is scarcely distinct from the upper part of the foot near its junction with the body.

Habitat as in the two preceding species. This animal is now noticed for the first time.

Ch. scalaris, Philippi.

Ch. scalaris, Brit. Moll. iii. p. 251, pl. 94. f. 5; and (animal) pl. F.F. f. 5; and iv. pp. 274 & 277.
Ch. rufescens, Brit. Moll. iii. p. 253, pl. 94. f. 1; and iv. p. 274.

Animal subhyaline-white, sometimes of a pale red muddy-brown, aspersed with minute, opake, snow-white points, inhabiting a white plicated shell of seven or eight volutions, with transverse striæ between the ribs, having the body marked with two or three narrow, spiral, light reddish-brown bands, and two on the penultimate volution; the apex is strongly reflexed on its next neighbour. Mantle even, except emitting a small cloven fold at the upper angle of the aperture. Rostrum deeply notched in front, with the segments gently arcuated. The tentacula are moderately long, strong, and divergent, and exhibit the usual folding auriform phases of their margins, but the varying inflations of the tips are less developed than in many other species. The eyes are black, not very close together, and fixed at the internal bases of the tentacula, which do not entirely coalesce, being divided by a distinct groove that is the continuation of one on the rostrum from the point where the cleft terminates. The foot is short, very slightly auricled, and on the march does not extend much beyond the body volution, posteally declining to an obtuse termination, at a little distance from which is the almost simple upper lobe carrying the usual pyriform elliptically-striated operculum.

Habitat: shelly mud, in 10 fathoms water, six miles from the shore, off Teignmouth, Devon.

This animal has scarcely been observed, and the only observation as to colour does not quite accord with the live specimens I have examined. I am now inclined to think, contrary to my opinion expressed in the 'Annals of Natural History,'

N. S. vol. vii. p. 387, that there are two varieties of this species: one, with turreted subangular volutions, which is considered the type, under the title of *Chemnitzia scalaris*; the other, with rounded volutions, which has the specific appellation of *C. rufescens*. I have taken both alive, and could detect no difference in the animals, except in colour; the *C. scalaris* being sometimes subhyaline frosted-white, at others pale red-brown, and the same variations attend the so-called *C. rufescens*. I may be in error as to the identity of the two, but that is my present impression.

Aug. 10th, 1853.—I took this day at the same haul two shells, one of which proved to be the typical *C. scalaris*, the other was the form termed by authors *C. rufescens*; they were both put in a vase, and being lively, I again saw that their organs were identical.

Ch. acicula, Philippi.

? *Eulima acicula*, Philippi.
Eulimella acicula, Brit. Moll. iii. p. 311, pl. 98. f. 9, 10; and iv. p. 283.
? *Eulimella affinis*, Brit. Moll. iii. p. 313, pl. 98. f. 7; and iv. pp. 274 & 283.

The animal inhabits a smooth, bluish-white, subhyaline shell of eight flat volutions, and has the reflexed apex, the constant characteristic of the *Chemnitziæ*. The mantle is even with the shell, with the exception of the small fold I have alluded to above; the body volution does not nearly equal half the entire length of the shell. The general colour of the animal throughout is subpellucid frosted-white, mixed with minute snowy flakes. The head or rostrum is, when fully extended, rather long, very broad, square in front, slightly emarginate in the centre, and on the march is always in advance of the foot, as is usual with the muzzle of the *Rissoæ*; it is grooved the whole length, and the groove is continued towards the neck, just separating the tentacula at their basal centre; at its upper surface, close to the base, is the orifice of the proboscis. The tentacula diverge almost at right angles, and resemble short, broad, minute leaves, each with an opake white stripe or stamen through the centre; they bevel to a fine edge, and with their large flexible margins can, like those of all the *Chemnitziæ*,

simulate the ear-shaped folds characteristic of those organs, which in this species are conspicuous, but the proteiform tips are only slightly developed. The eyes are very black, not quite close to each other, and immersed a little posterior to the internal bases of the tentacula. The foot is rather long, extending to two volutions, very thin, in front bluntly auricled, terminating, when in full march, in an acute point, and carrying, on a simple lobe at the junction of the foot with the body, a pyriform, light corneous operculum, marked with arcuated oblique striæ of growth.

The animal is free, creeps with rapidity, and dwells in muddy ground mixed with shelly spoil in 14 fathoms water, off Teignmouth, Devon. This species has never before been observed alive.

I have examined several live specimens of that variety of the present species termed by authors *Eulimella affinis*, and I find that the animals of the two are identical; the only difference is in the shell, which in the "*affinis*" is more taper, and has the whorls more rounded and better defined by the divisional lines.

Ch. fenestrata, Forbes.

Ch. fenestrata, Brit. Moll. iii. p. 249, pl. 93. f. 6, 7; and iv. p. 277.

Animal inhabiting a longitudinally-plicated and spirally-ridged, white shell of eight rather flat volutions, which bevel from their bases to the sutural lines; the apex has the usual reflexion of the tribe. The general colour of the external organs is a subhyaline frosted-white, the internal posterior volutions are a deep red-brown. Mantle even with the aperture, except a small shoot at the upper angle. Rostrum slender, long, flat, barely hollowed at its termination. The tentacula are comparatively long and slender; they fold after the characteristic manner of the tribe, and have the white inflated tips; they are united at the bases, on which, close together, are imbedded at the internal angles the conspicuous black eyes. The foot in slow march is short, broad and obtuse, but when the pace is accelerated, it becomes attenuated and

extends to the bottom of the second basal volution; anteriorly it forms a concave sweep, ending on the right and left in very slight auricular points; posteriorly it has a moderate lanceolate shape, carrying, on a simple lobe close to its junction with the body, a light corneous, pyriform, obliquely-striated operculum. This elegant little creature is very vivacious, and free from shyness.

Habitat: muddy ground, in 10 fathoms water, six or seven miles from the land, off Exmouth.

It is one of the undescribed species.

Ch. insculpta, Montagu.

Odostomia insculpta, Brit. Moll. iii. p. 289, pl. 96. f. 6; and iv. p. 280.

The animal occupies an ivory-white shell of five moderately rounded volutions, with well-marked, but not oblique, sutural lines; the three lower whorls at the basal portions have very fine, distant, either concentrically circular or spiral striæ. The colour is opake frosted-white, with a rather large patch of dull claret-red on the neck. The mantle has the usual fold at the upper angle of the aperture. The rostrum is short, cloven nearly to the eyes, with the segments arcuating as in *C. obliqua*. The tentacula coalesce at their bases, and are very broad and short, which condition may, in some measure, be owing to the margins not being folded in the auriform fashion on the march; they terminate in very small, white, slightly inflated tips; the eyes are close together at the internal bases. The foot appeared short and broad as the animal moved in slow march, but perhaps, if the pace had been accelerated, it might have been somewhat extended; in front it is gently concave, with blunt auricles, close under which it becomes a little constricted, and terminates in a deep regular emargination carrying on a plain lobe a remarkably thin, light horn-coloured, narrow, subelongated, obliquely-striated operculum.

It inhabits a shelly bottom in 14 fathoms water, six miles from shore at Exmouth. It has not been examined before.

Exmouth, June 15th, 1853.

A lively specimen shows that the foot is deeply notched in front, forming divergent acute auricles, instead of being gently concave; when fully extended, it reaches to the second volution, terminating in two symmetrical distinct pointed tails or streamers, which describe an angle of separation equal to that of the fore and middle fingers when placed as far apart as possible. This structure is of normal character, and not a mere emargination.

Ch. obliqua, Alder.

Odostomia obliqua, Alder.

———— ————, Brit. Moll. iii. p. 291, pl. 96. f. 1; and iv. p. 280.

The animal inhabits a very pale yellowish-white smooth shell of four rather tumid volutions, besides the apical reflexion, which is less than usual; the divisional lines are by no means oblique, and the body exceeds the length of the spire; its colour is a brilliant frosted subhyaline-white. The mantle is even, except a conspicuous tubular fold at the upper angle of the aperture. The rostrum is short and cloven in the centre almost to the eyes: each segment forms an arcuation to each side equal to an angle of 40°. The tentacula are strong, rather long, without much auriform folding, subrotund and taper, terminating with minute circular snow-white spots or inflations on the tips; the eyes are close together at the internal basal angles: the great peculiarity attached to the tentacula is, that instead of a moderate divergence on each side the rostrum, they form large arcuations, and are carried at right angles to the axis of the shell. Foot thin, rather concave in front, slightly auricled, long and broad, and, when fully extended, reaching beyond the body whorl, terminating in a distinct bifurcation, which is very apparent in slow march, but on a quicker pace being attained, the fork in some measure decreases in consequence of the greater extension of the foot: on a small simple lobe, close to the junction of the foot with the body, is fixed an elongated, narrow, corneous, delicate light yellow operculum with close-set oblique striæ of growth.

Taken at Exmouth from a shelly bottom, six miles from shore, in 12 fathoms water. It has hitherto escaped the researches of authors.

I have thought the "*obliqua*," if not a variety of the *C. Warrenii* (the *C. decorata* of authors), a doubtful species, but the above description certifies its distinctness.

Ch. Gulsonæ, Clark.

Chemnitzia Gulsonæ, Clark, Ann. & Mag. Nat. Hist., N. S. vi. p. 459.
Odostomia Gulsonæ, Brit. Moll. iv. p. 281, pl. 132. f. 6.

C. testa tenui, lævi, anfractibus quinque cylindrico-tumidis, subobliquis. Apertura elongato-ovalis, peripheria integra, tenui, paululum reflexa, ad externum labium leviter constricta. Sutura simplex. Apex rotundato-obtusus, subreflexus. Color albus, vel pallide luteus. Axis $\frac{1}{10}$, diameter $\frac{1}{20}$ unciæ.
Habitat propeostia Iscæ Damnoniorum.

A minute and elegant species, which appears unaccountably not to have been noticed, until described by me in the 'Annals.' I ascertained that it was unpublished, having even escaped the attention of the learned authors of the 'British Mollusca.' Under these circumstances I considered it a paramount duty, as a faithful knight of this branch of natural history, to fly to the rescue; and I hope, by the aid of my good lance, to convert the undeserved neglect of this rare object into an imperishable renown, by giving it, for a specific appellation, the name of a lady at Exmouth, who has devoted her leisure to the cultivation of natural history, and by her illustrations and discoveries in the departments of algology and conchology, has done much to promote the advancement of science. May more of our fair countrywomen follow her example! These pursuits not only delight and adorn their votaries, but they add new facts and new discoveries to our stock; and it is only by the exertions of many, distributed over the face of the land, that novelties are brought to our knowledge. The harvest is not yet gathered in, and the lady who discovers a new species, gains an immortality co-extensive with the existing order of nature. I refrain from adding to

this simple acknowledgement of rare merit, lest I should offend those retiring sensibilities, which are always the concomitants of true science.

This elegant shell, of five and a half rather tumid volutions, has much the contour of some of the subelongated species. I felt little doubt that it was a true *Chemnitzia*, and deposited it in that genus until our knowledge of the animal should determine its position.

It is a rare species: I possess three perfect specimens. The characteristic obtuse, yet reflexed apex, induced me to place it amongst its congeners of similar apical configuration, which is almost peculiar to the *Pyramidellidæ*. I believe that *Ianthina* is the only other genus that has something of a similar structure, but in it the apex presents rather a distorted irregularity than a true reflexion; but whether this be so or not, the connecting characters between *Ianthina* and *Chemnitzia* are of little value.

Soon after the above description appeared in the 'Annals,' I had to announce the unexpected discovery, which was so forlorn a hope that even the Gods would hardly have dared to promise its fulfilment, of perhaps one of the rarest of the British Gasteropodan undescribed molluscan animals; the cause has perhaps been its anomalous aspect. This rare creature was met with in the coralline zone of the South Devon coast, at Exmouth, in 13 fathoms water; it remained alive three days, and furnished me with the minutes which I now submit.

Animal inhabiting an elongated, slender, hyper-hyaline shell of six rounded volutions, the body occupying half the axis, with a large patulous, sinuated, and a little outwardly reflected aperture, the peristome of which is entire. The animal rarely protrudes the eyes and tentacula. The tip only of the effete muzzle is seen, and a part of the foot, which is so short as almost to allow of progression within the aperture. The shell is of such hyaline purity as to give a full view of the organs, as if they were without that protection. The mantle is flake-white and even with the shell. The neck is very long, cylindrical, like that of the *C. spiralis*, and finely transversely corrugated,

ending at the tentacula, which, though somewhat apart, are united by the usual membrane of the *Chemnitziæ*; they are thick, broad, short, not very membranous, rounded at the tips, which have the characteristic minute flake-white lobe or inflation. The black eyes are not very near together; they are immersed *exactly* and close to the base of each tentaculum, on minute white circles; they do not in the least invade the area of the neck, but rather impinge on the stamens of the tentacula. The effete muzzle or mentum is undoubtedly the continuation of the neck, and has no connection with the foot; it is long, slender, grooved at the margins anteally and on each side, the upper and lower surface being perfect and unbroken; the vertical fissure of the mouth is under the tentacular awning. The foot is of the palest frosted-yellow, exceedingly short, narrow, deeply bifurcated in front, when at rest rounded behind, and a little lengthened in action. The animal examined was an "*Alma Venus*," and, when fully retracted, occupies the fourth volution; the light green liver, and very pale red, granular ovarium, occupy the three primary volutions; but when the animal is fully out in the body of the shell, the liver and ovarium are altogether withdrawn from the first whorls, leaving them perfectly hyaline; they are then deposited in the lower part of the third and the whole of the fourth volution, the other parts of the body and organs being in the fifth and sixth. The narrow arcuated branchial plume of about 15–18 rather coarse, opake, pale drab strands, with the auricle and heart, distinguished by their intense snow-white colour, are perfectly visible, under a powerful Coddington lens, at the smaller and posterior end of the branchial plume. I have been thus particular as to the site of the organs, because I never met with a shell so perfectly hyaline in which their position could be so well seen. The operculum is an almost invisible film, pear-shaped or suboval, with a narrow border of pale bistre with a pinkish hue; the striæ of increment radiate as in most of the other *Chemnitziæ*; it is fixed on a plain lobe near the posterior extremity. I saw no ornamental appendages to the head and neck. In this example the apex is sub-

reflexed, and there is a rudimental denticle on the pillar-lip. Axis $\frac{1}{12}$, diameter $\frac{1}{30}$ unciæ.

This very rare animal is an undoubted *Chemnitzia*, and probably the first of the species that has ever been seen alive. To add to the interest of this little narrative, I may state, that Mrs. Gulson, who last year allowed me the honour of attaching her name to this elegant shell, saw and examined her namesake in a living state.

I have searched in vain for a second example of this rare animal, as I am anxious to review it; however, I do not despair of again meeting with it.

Ch. Barleei, Clark.

Ch. eximia, Brit. Moll. iv. p. 278, pl. 90. f. 1 (as *Rissoa eximia*).
Rissoa eximia, Jeffreys.

Bath, 17th January, 1851.

My friend Mr. Barlee presented me some time ago with a minute shell, which he considered an unpublished *Rissoa*, but, on examination, I found it had all the conchological characters of a *Chemnitzia*. Mr. Barlee obtained it in the Shetland Islands. That the honours due to him may not be taken up by some Bathyllus, I insert the following account of it.

C. testa gracili, alba, costis circa duodecim subrectis instructa, anfractibus quatuor rotundatis, quorum primus in sequentem reflexus, alter duabus, tertius et ultimus striis tribus spiraliter cincti. Apertura subovalis, haud continua, labium columnare plica obsoleta, vel penitus abdita, latus externum sine callo. Sutura linearis, distincta. Umbilicus vix notatus. Axis $\frac{1}{12}$, diameter $\frac{1}{30}$ unciæ.
Hab. ad insulas Zetlandicas.

These characters indicate, as far as conchological ones can, that the animal, when observed, will prove a *Chemnitzia*. The outer lip is without the callus of most of the *Rissoæ*; the apex is undoubtedly reflexed, a character which is generally the concomitant of the *Chemnitziæ*. I believe no example of a *Rissoa* with a similar apical structure is known; we may say that there is not a single essential character of the *Rissoæ* in this species. It is a congener of *Chemnitzia excavata*:

at one time I thought it a variety of that species, but the different disposition of the spiral striæ, the more oblique ribs and hollowed-out volutions in the *C. excavata*, show that the *C. Barleei* is distinct, though most closely allied to it. The apex of *C. excavata* is reflexed precisely as in this species. This character with me, as regards the *Chemnitziæ*, is of great value; in that tribe the decidedly reflexed apex, or the sunken subreflexed one, I never found absent. But the examples must be fresh and perfect—not the usual cabinet ones ground to button-like apices by attrition; but even in these the practised eye will detect the true character. The fold on the pillar-lip of the *C. excavata* is sometimes present, and at others absent. I believe this remark holds good in this species; but in my specimens from Mr. Barlee it is distinctly visible, though very small, and far retired within the aperture.

Ch. nitidissima, Mont. et Auct.

Aclis nitidissima, Brit. Moll. iii. p. 223, pl. 90. f. 6, 7.

Though the animal of this elegant minute shell remains undiscovered, still the inversion of its apical turns on the succeeding volution is so excellent and faithful a characteristic of the *Chemnitziæ* (of which I am not aware of an instance of failure), that I am induced, without hesitation, to consider this species as a member of that genus, and I confidently expect that, when the animal is *déterré*, it will support me in the step I have taken. This character, which I think of great value as a conchological aid, is far preferable to the unstable columellar fold.

Ch. excavata, Philippi.

Odostomia excavata, Brit. Moll. iii. p. 305, pl. 97. f. 3, 4.

This species has not been met with alive, though the shell, in excellent condition, has been taken at Exmouth.

Ch. Scillæ, Scacchi.

Eulimella Scillæ, Brit. Moll. iii. p. 309, pl. 98. f. 5, 6; (animal) pl. F.F. f. 7.

This species does not inhabit the Devonshire coasts.

Ch. nivosa, Montagu.

Odostomia truncatula, Brit. Moll. iii. p. 294, pl. 96. f. 8 (adult).
O. cylindrica, Brit. Moll. iii. p. 287, pl. 96. f. 7 (juv.).

The animal has not occurred.

I have now stated all that I know, agreeably to my views, of this difficult and interesting genus, and corrected some popular errors as well as those of observation, and particularly many of my own; for however greatly our *amour propre* may suffer by such admissions, there is absolutely no other alternative but to make them, as, if omitted, or not made at the proper moment, we should be left pretty much in the same position as the Chancellor of the Exchequer's regiment of conscience-money payers,—a curious public fact, illustrative of one of the mysterious operations of the human mind, which if properly pondered on, will suggest to us all, in respect of the present and the hereafter, many salutary, important, and high considerations.

I have more than once alluded to these points, but when I see gross and persevering error stalk abroad, sapping the foundations of science, and rendering everything uncertain by disingenuous fabrications, and appropriations of other men's labours, one cannot always hear and hold our peace,—

> "Semper ego auditor tantum? nunquamne reponam,
> Vexatus toties?"

One word more on the useless practice of stringing together long lists of bare names, habitats, and scales of rarity, without a syllable of distinctive matter, either on the animal or shell; these things are all very well as adjuncts of description, but without it, worthless and unmeaning expletives. Science does not consist in the fabrication of hard and empty names, which convey no more information than the perusal of pages of "*Aldiborontophoscophormio*," and the changes that can be rung on that celebrated cabalistic compound. I trust enough has been said to discountenance such meretricious attempts to personate true science; conscience must stamp them as the

offspring of inordinate conceit, and the selfish vanity of gratifying, "*coûte qui coûte*," the morbid cravings after public notoriety.

EULIMA, Risso.

This genus shows a still nearer approach to the *Muricidæ* than *Chemnitzia*, with which, however, it is closely allied, though distinct in several points; the mute rostrum has entirely disappeared, the tentacula are short, conically tapering to a point, and not flat, triangular, auriform and folded as in that genus; they have less basal coalition, and the eyes, though fixed at their bases, are less internal, being exactly medial. Both genera have the proboscis strictly "*recondenda*," with a very long unarmed lingual riband. The anatomy of the minute *Chemnitziæ* is, I believe, unknown; therefore a comparison cannot be made with *Eulima*; we only mention, that in it there is an excessively long vas deferens or epididymis, as in *Murex undatus*. We have dissected many of the *E. polita*, but never found in the proboscis, or lingual riband, the least appearance of spinous processes. It is probable that the buccal apparatus of all the *Chemnitziæ* is destitute of the spinous tongue. The conchological alliance of this genus with *Chemnitzia* is excellent, as it has the same inversion of the apical volutions. What has been mistaken for the mentum by some authors,—not by Lovèn, who does not mention such an organ in *Eulima*,—is an integral part of the disk of the foot, which, in the adult animals of *E. polita*, is always marked with bright orange-coloured segments of a circle, and is the usual labium that divides the upper skin of the anterior portion of the foot from the sole. I have not only seen but dissected the retractile proboscis of *Eulima*, which is very similar to that of *Chemnitzia*; it consists of two retractile tubes, an inner and an outer one, as in *Murex undatus*. Though the long flat tongue appears quite smooth, there is, nevertheless, in the inner cylinder, the appearance of a shagreened, roughened portion, which may be tantamount to the denticular apparatus of the inner tube of the *M. undatus*.

E. POLITA, Linnæus.

E. polita, Brit. Moll. iii. p. 229, pl. 92. f. 1, 2, 3; (animal) pl. K.K. f. 2, 3, and iv. p. 273.
E. nitida and *E. distorta*, Auct.

Animal of twelve to sixteen spiral turns, inhabiting a white, highly-polished, porcellanous, conically-tapering, subulate shell. Mantle white, fleshy, fully lining the aperture, but there is no reflexion or extension of it to account for the perfectly glabrous aspect. Head moderately large, flattish, not much produced; mouth below vertically cloven. The tentacula are short, conical, pointed, nearly united at the bases, diverging gradually to their terminations; the basal halves are pure white, the terminal portions yellow or orange, sometimes of a greenish-yellow. The eyes are large, and when the animal marches, generally lie under the anterior margin of the aperture, but from its tenuity and lustre are easily observed; they are very rarely exserted beyond the limits of the shell, and are fixed at the centres of the bases of the tentacula; they are mounted on minute orange-coloured eminences. The foot is small, short, seldom extended beyond the basal whorl, truncate and auricled anteriorly, very moderately acuminated behind; the sole in front is separated from the upper skin by a groove, forming double labia, and carries on the operculigerous lobe a thin, light horn-coloured, flexible, suboval, obliquely-striated operculum. The anterior upper margin of the foot is bordered by two linear segments of a circle, with the convexity outwards, but indented in the middle, of a bright orange-yellow; but these colours, intensely marked, are only observable in adult specimens, the younger ones being white. I have omitted to mention, that several portions of the foot are more or less tinctured with orange-yellow. The verge of this species springs under the right tentaculum; it is rather long, pale yellow, flat and strap-shaped for two-thirds of its length; at the end it becomes more spread and falcate, with two short orange-coloured stripes at the terminus, where the orifice is placed. The testis is an elongated oval, yellowish lobe, situate in the posterior volutions, and communicating with the verge by a long, wrinkled, tor-

tuous, filiform vas deferens or epididymis, like that of *Buccinum undatum* (our *Murex undatus*); it is at least 2½ inches long, or three times the length of the shell. The tongue is also of extraordinary length, flat, strap-shaped, and without a spinous armature. There is a single branchial plume in the usual place; it is small, narrow, of twelve to fifteen short coarse strands, with an arterial or branchial vein in the centre; indeed we are not quite sure that the plume is not double; the colour is pale drab. We have not observed an incipient fold of the mantle, but whether it be there or not, we have sufficient evidence of an approach to the Muricidal tribes; and after we have given some notes on *Scalaria*, *Ianthina*, *Natica*, *Lamellaria*, and *Velutina*, our scheme of natural order from the *Bullidæ* to the Muricidal families will be sufficiently developed.

It is scarcely doubtful that the *E. nitida* is a mere variety of the type, *E. polita*, and the two varieties of *E. distorta* are the young. The *E. polita* is lively, not at all shy, and inhabits the coralline zone at Exmouth in abundance. The other acknowledged British species are the *E. subulata* and *E. bilineata*, but their distinctness admits of doubt.

E. DISTORTA, Philippi, Moll. Siciliæ.

E. distorta, Brit. Moll. iii. p. 232, pl. 92. f. 4, 5, 6; (animal) pl. K.K. f. 4.

We have considered this arcuated shell as the young of *E. polita*, but having obtained some living examples, we offer a description, that naturalists may judge for themselves.

Animal inhabiting a glabrous, transparent, arcuated or distorted shell of 8–10 volutions; the ground colour is flake or pure white, and the anterior part of the body is marked irregularly with 15–20 distinct minute red dots. The liver in our various examples, as seen through the shell, is yellow, red, pink, light green and white, and the same variations, with the addition of purple, occur in *E. polita*. The tentacula are pure or frosted white, and appear proportionately rather longer, flatter and less conical, than in *E. polita*; their termini have the characteristic flake-white tips or minute lobes of

the *Chemnitziæ*, which are not seen in the fully adult *E. polita*.

With respect to the tentacula, we may state, that in all the young *E. polita*, under half an inch in length, they are quite white and the arcuated yellow lines in front of the foot are wanting; they are also flatter, with rudimental flake tips; but with age all these young incidents disappear. All the *Eulimæ* are more or less distorted or arcuated posteriorly, but increase of growth diminishes the effect of what is so apparent in the young shell.

The operculigerous lobes of the animal are as unequal as in *E. polita*. The foot of this minute example appears proportionately more slender and hyaline than in the adult; it has a labium well separated from its upper skin, which some authors call a mentum; but, even admitting that term, the organ is very different from that continuous neck-production in the *Chemnitziæ*, which we have styled a rostrum, and M. Lovèn the mentum.

The animal is extremely free and vivacious; it delights in swimming, and marches with far more celerity than the adult *E. polita*. Axis of the specimen examined $\frac{2}{10}$, diameter $\frac{1}{30}$ unciæ. It is found plentifully in company with the *E. polita*, and that variation termed *E. nitida* by the Scotch naturalists, in the coralline zone at Exmouth, and off Teignmouth, in a fine muddy and shelly bottom, in 14 fathoms water.

The following have not occurred to me alive:—

E. SUBULATA, Donovan.

E. subulata, Brit. Moll. iii. p. 235, pl. 92. f. 7, 8.

E. BILINEATA, Alder.

E. bilineata, Brit. Moll. iii. p. 237, pl. 92. f. 9; (animal) pl. K.K. f. 5.

We believe that the latter is the young of the former.

ACLIS, Lovèn.

This genus contains only two very rare British species, the *Turbo ascaris* of Turton and the *A. supranitida* of S. Wood;

the animal of neither has, I believe, occurred to a British observer; we earnestly request the discoverer of either to examine it carefully and communicate his notes, as the animal requires further investigation before its position can be permanently settled. It is doubtful whether the *Turbo ascaris* of Turton ought to enter M. Lovèn's genus; however, as it is only an ad-interim deposit, we give his generic diagnosis:—

"Animal slender; head not proboscidiform; tentacula slender, cylindrical, somewhat inflated, approximating at the bases, at which points the eyes are immersed and externally inclined; there is a long, strong, and recondite proboscis; tongue simple?; the upper lobe of the foot is divided from the sole, which is narrow and produced. The operculigerous lobe is large, differing in shape on each side; the right one is the largest, with three to four plications; the left forms a single rounded lobe, posteally produced into a fold. The sole of the foot is tongue-shaped, and anteally truncate. Operculum? Shell turreted, rough or pitted, having numerous volutions furnished with elevated spiral striæ or sharp ridges. Aperture oval."

Though this genus appears to have several connecting links with the two preceding ones, the above generic characters are so very distinct in many particulars, that it is unnecessary to make any comparative observations. The discovery of the animal of our *Turbo ascaris* will clear up all doubts.

A. ASCARIS, Turton.

A. ascaris, Brit. Moll. iii. p. 219, pl. 88. f. 8.
A. supranitida, S. Wood.
————, Brit. Moll. iii. p. 220, pl. 90. f. 2, 3; and iv. p. 273; (animal) M.M. f. 5.

Since the above was written we have ascertained that the *A. ascaris* and *A. supranitida* are varieties of each other; the first is spirally striated, the latter apparently smooth, but under the lens the obsolete striæ are visible on all the volutions. It is curious, that whilst M. Lovèn scarcely mentions the animal of *Eulima*, he gives elaborate generic characters of *Aclis*, of which he considers the *A. supranitida* of Searles

Wood the type; but, what is more curious, his diagnosis of the genus fits *Eulima* as well as if it had been written for that genus. This at all events proves the close alliance of the two genera, even if they be distinct. The apices of the *Eulimæ* and *A. supranitida* are similar; more mammillated and vitreous, and less reflexed than in *Chemnitzia*. We have a beautiful fresh specimen of the variety "*supranitida*," taken at Plymouth, by hands unaccustomed to animal examination; it is therefore still a desideratum.

STYLIFER, Broderip.

We have hesitated to include this genus amongst the Pyramidellidan tribes, yet it would be difficult to find a more suitable position, at least for the present: we have our suspicions, that when the proboscidal structure and the reproductive organs are made known, it may possibly pass to the vicinity of the *Naticæ* or *Velutinæ*; at present, however, we may observe, that the conical tentacula and external position of the eyes remove it from the *Bullidæ* and *Conovulidæ*. As a *Pyramidella*, it will be the only species without an operculum; but if the tongue is unarmed, that would be an approximation to *Eulima*. The case is surrounded with difficulties only to be removed by a more extended investigation of the animal: we strongly recommend it to the attention of naturalists. During the last thirty years I have examined hundreds of various species of *Echini*, in vain, for this rare animal.

S. Turtoni, Broderip.

S. Turtoni, Brit. Moll. iii. p. 226, pl. 90. f. 8, 9; (animal) pl. O.O. f. 5.

We have never met with this rare animal, and refer to the 'British Mollusca' for all that is known of it. Mr. A. Adams mentions it in his notes on sundry Mollusca in the 'Annals of Natural History,' vol. xix. p. 415, old series: from the account of the foot, it would appear that it can scarcely belong to *Natica*.

PELORIDÆ, nobis.

Animalia, quoad testam formæ variabilis, nunc *Naticam*, *Sigaretum*, nunc *Bullam*, aut *Scalariam* simulantia; apertura integra vel canali obsoleto; quoad organa essentialia, summæ consensionis; semper proboscide retractili plus minusve longa prædita; pallio ad latus columnare canalem brevem efformante.

Having, agreeably to my method of the classification of the British Mollusca, constituted the family of the *Peloridæ*,—forming, as I think, one of the approaches to the *Murices*, —I have thought that it would be a proper attention to naturalists, and justice to myself, to assign the reasons for the step I have taken, by giving some account of the singularly anomalous genera and species that compose the new family, which, though often mentioned,—and some of them have even fallen on good ground with respect to natural order,—have not received the attention they deserve. My object is to give these aberrant animals a more collective form and improved arrangement, with respect to their connexion with the Muricidal tribes, until better are proposed; for in the present age we see that the highest intelligences in every science are scarcely more than ephemeral,—"summisque negatum stare diu." I have also supplied fuller descriptions of the British species, and hope I have interspersed some observations that have hitherto escaped the attention of naturalists.

Several of the species were known to Linnæus and his followers, but the older zoologists being comparatively ignorant of the animals, have transferred them from genus to genus, and the moderns have not yet succeeded in bringing all of them to a safe anchorage. I have felt a difficulty in uniting these wanderers, almost without a home, as aberrant sections of the strict *Muricidæ*, though the animals have some of the essential organs of that family, and it would be still more inconvenient to locate them in any of the existing families of the Holostomata. I have considered that the best plan would

be to form for the *Ianthinæ, Scalariæ, Naticæ, Lamellariæ,* and *Velutinæ,* a family, combining the respective characters of the holostomatous and canaliferous divisions of the Gasteropoda, as, by their entire apertures, they have, conchologically, an affinity with the former tribe, and by the retractile proboscis, malacologically, the closest alliance with the Canalifera. Naturalists must therefore either raise each of the above genera to the rank of families, which at best can only have conchological variations, and scarcely any very essential malacological distinction, or deposit them for conciseness' sake in a neutral one, under an indifferent term, embracing the principal attributes of the five genera. I propose the appellation of the *Peloridæ,* from the *Peloris* of the ancients, probably a testaceous animal, but whether of the holostomatous or muricidal race is doubtful; the name is therefore the more appropriate for a family of hybrid and transitive pretensions. The position of the new family would be between the *Pyramidellidæ* and *Muricidæ*: its genera, with the *Chemnitziæ* and *Eulimæ,* which also have an entire aperture and retractile proboscis, may be said to occupy a sort of debateable ground between two of the great divisions of the gasteropodan domain.

These anomalous genera must not be looked on as freaks of nature; they are her avenues from one division of a class to another. Under the respective genera will be pointed out the curious characters that connect them with particular groups, and also the various points of difference between them, which, though conchologically great in appearance, when malacologically examined will exhibit striking similarities: for instance, *Ianthina* and *Scalaria* are inseparable, as are *Natica, Lamellaria* and *Velutina*; but notwithstanding their respective discrepancies, they all have various connecting links, decidedly showing that they form a single family about to blend with the strict *Muricidæ.* Many considerations have induced me to propose the family *Peloridæ.* Abstractedly, I would rather have preferred the transfer of its proposed genera as sections of the *Muricidæ,* with which group they appear to have the greater approximation; nevertheless, for the present I abandon this

view, on the plea that one intermediate family would be less repugnant to the feelings of conchologists, and even of some malacologists, than the adoption of five families, or the creation of five sections of essentially the same malacological structure. However great may be the disapprobation of naturalists at these changes, we feel it to be our duty to see that nature is satisfied before conchological hypothesis, and we fearlessly invite malacologists to point out a more natural site for these creatures, than as a united anomalous group, immediately abutting on the Muricidal tribes.

This family will conspicuously illustrate the great advantage, nay even the triumph, of malacological facts over conchological considerations, and point out the little reliance to be placed on the *form* of the hard parts as distinctive characters. What conchologist would have ventured to associate these anomalous genera in the same circle? Conchology could never have given to these singular objects an appropriate constitution: without the assistance of malacology they would for ever have remained a nomadic tribe, and indefinitely the sport of hypothesis.

IANTHINA, Lamarck.

This singular genus appears not to be indigenous to any of the coasts of our globe; it has a truly oceanic habitat amidst the mighty waters of the Atlantic and Pacific; but the various species are occasionally wafted to the different shores of the world. More than twenty years ago, many of the *Ianthina communis* were brought to us alive, though collapsed, collected on the South Devon coasts; but I believe none have appeared since in those localities.

This genus has long caused embarrassment to naturalists, and is still a source of difficulty in regard to the structure of the animal and its natural position; but I think the obstacles to a true determination will disappear on attentive consideration. The great stumbling-block is the float, as it is called, or vesicular mass attached to the foot, which has been considered an hydrostatic apparatus. This idea is erroneous:

the organ is the membranous vehicle of the contents of the ovarium and matrix, that has descended from under the mantle, and fixed itself to the foot, for a very obvious purpose of the animal œconomy in reference to the pulli in the genial season. It is probable, that as the animal, from its peculiar habitat, cannot, like the tribes of the coasts, deposit the germs of reproduction on marine substances, it makes use of the foot as a substitute, until its young emerge from the agglomerated mass of capsules to shift for themselves; then the temporary vesicular deposit is cast off. I have seen a similar appendage to the foot of the *Pileopsis hungaricus* and several other Gasteropoda.

That this organ is not necessary for the floatation of the animal is strongly supported by the fact, that, as the sexes are distinct, many may be presumed to be males, and such often occur, without the so-called float. Many of the *Littorinæ* with a shell ten times more ponderous in proportion than the globular delicate *Ianthina*, float with the shell beneath, and foot uppermost, in every direction, for days, without descending from the surface of the waters.

It will be seen that the other parts of the animal scarcely differ from the more regular gasteropod. The double branchial plumes, one of them with two ranges of strands; the small head, the retractile, though short, inflated proboscis, and the rudimentary mucous fillets, which latter are only seen in the Canalifera, show that *Ianthina* is in the vicinity of *Murex*. It has been thought to approach *Trochus*; I am not of this opinion: the above characters, with its oceanic habitat, food and habitudes, and absence of operculum, seem entirely to remove it from that genus, to which it would be difficult to find a colourable approach; and above all, we may observe, that the illustrious Cuvier, by his dissection, places it in the category of the *Muricidæ*.

I therefore deposit *Ianthina* as the first member of the new family, forming, with the *Eulimæ* and *Chemnitziæ*, the passage from the tribes with entire apertures to the Canalifera. The aperture in *Ianthina*, by its columellar elongation and canaliferous tendency, shows that it is in a state of transition, and

the short neck and head, with the retractile rostrum, point out that in the soft parts there are also the elements of transition.

I. COMMUNIS, Lamarck.

I. communis, Brit. Moll. ii. p. 549, pl. 69. f. 6, 7; and iv. p. 260, pl. 133. f. 1.
I. pallida, Brit. Moll. ii. p. 553, pl. 69. f. 10, 11.

Animal inhabiting a spiral, subglobose, bluish-white or lilac-coloured shell of four tumid volutions and a minute reflexed apex. Mantle lax, swelling beyond the margin of the aperture and forming an incipient canal. The neck and head are very short, but capable of evolving an inflated, retractile proboscis, which has been mistaken for the head itself; it is armed, as in the *Murices*, with corneous plates and the usual short spiny tongue. Tentacula short, conical, pointed, with deeply cloven offsets of half their length; but the eyes are obsolete, probably being useless, as the animal floats with the shell downwards and the foot to the skies. Foot truncate anteally; auricled at the external angles, moderately long, gradually tapering to a point. On the under part, the animal in the genial season deposits the vesicular mass containing the ova and pulli, ejected from the matrix; it exudes from the collar and surface of the body a purple liquid. There are two branchial plumes, one with a double row of strands; there are also the rudiments of mucous fillets; in fact, all the organs resemble those of *Murex*. I should rejoice to review this species, as my examples, though alive, were torpid from the effect of the agitation of the tides on the shores, consequently there was no adequate protrusion of their organs.

I beg malacologists to lose no opportunity of rigorously examining these animals, as there are still points in their structure on which it would be desirable to have further information; amongst them the constitution of the proboscis, whether it be strictly the *proboscis retractilis* of the *Muricidæ*. M. Cuvier insists again and again that it is retractile, assimilating it to that organ in the *Buccinum undatum*, which he has so elaborately described, and stating that when he treats

of that muricidal animal, the mechanism of *Ianthina* will be better appreciated by comparison. Therefore, after M. Cuvier's particular and minute account, that the proboscis in this species is a great and inflated, though short muzzle, which can be retracted *within* the buccal sheath, we must bow to such high authority; but independently of this fact, there are other characters which sufficiently declare that this extraordinary animal can have no other allocation than in the vicinity of the *Muricidæ*.

This is the only species I have had an opportunity of examining; one or two other rarer ones are sometimes found in company with it, as the *Ianthina exigua* and *I. pallida*; the last I think is only a variety of the present species. These animals have no operculum.

The following has not occurred to me alive:—

I. EXIGUA, Lamarck.

I. exigua, Brit. Moll. ii. p. 555, pl. 69. f. 8, 9.

SCALARIA, Lamarck.

This genus contains several British species. Authors and Lamarck's commentators say, that it is allied to *Turritella*, but I think that it has much greater affinity with the Canalifera. *Turritella* and *Scalaria*, in addition to the single branchial plume, appear to have the mucous strands of the *Muricidæ*, which are always provided with that appendage, besides the gland of viscosity. In other points, *Turritella*, by its short, produced muzzle, circular operculum, and the absence of a proboscis, comes nearer to the *Littorinæ* and *Trochi*, whilst *Scalaria*, with the mucous fillets, has also the decided proboscis of the Canalifera; consequently it must be assigned, as a muricidal anomaly, to the new family of the *Peloridæ*. However, whatever may be the affinities of the two genera, they will not be far apart; the one claiming, by its slightly developed canal, both of shell and mantle, to take position on the confines of the Holostomata, the other on those of the Canalifera. An attentive perusal of the account of the undermentioned species will show that the *Scalariæ* are truly strange

animals; the spiral operculum, single branchial plume, and almost entire aperture, indicate their relation with the *Littorinæ*, whilst the mucous fillets and prominent retractile proboscis, the latter a character of the highest value, fix them amongst the immediate points of transition to the *Muricidæ*.

S. CLATHRATULA, Montagu.

S. clathratula, Brit. Moll. iii. p. 209, pl. 70. f. 3, 4.

Animal occupying a densely plicated, milk-white, spiral shell of 9–11 volutions. The animal nearly throughout is bluish-white, aspersed at the points of the tentacula, on the head and neck, and margins of the foot, with blotches and spots of snow-white matter. Mantle fleshy, reflexed on the peripheral rib of the aperture, and forming also a short, lax, branchial fold to correspond with the incipient canal of the shell. The head, though very short, is distinct, compressed and crescent-shaped, as in *Murex*; beneath slightly emarginate in the centre, at which point is the mouth, which is partially, transversely and vertically cloven; from this a long, strong, fleshy proboscis is exserted, which I have repeatedly seen evolved several times in a minute. The tentacula are moderately long, divergent, subcompressed, with blunt terminations. The eyes are very black, not fixed on offsets, but on scarcely raised eminences or decidedly external semicircular inflations which are integral parts of the bases of the tentacula. The foot can be extended beyond the tentacula; it is nevertheless short, narrow, and bevelled on both sides, arcuated gently in front when on the march, and slightly auricled; at rest subtruncate; it is also grooved transversely in front, dividing the sole from the upper part, and forming a distinct labium, the sole being somewhat the longest; it tapers to a slender, rounded termination, carrying at some distance from the extremity, on a simple lobe, a white, spiral operculum of three turns; the first two are very small and eccentric, the third rapidly increases and occupies $\frac{9}{10}$ths of the area, and is marked with elliptical striæ of increment. The posterior half of the foot is deeply grooved longitudinally and medially in the sole with a central depres-

sion, exactly as in *Murex tubercularis*, but not quite so decidedly:—it is probable that this groove, and apparent, if not real, solution of continuity, is not solely to convey water to the foot, but also to assist the folding of that organ on its anterior portion, and the central pit is to aid another doubling at right angles. I witnessed the operation both in retraction and when the animal deployed the foot, which confirmed that part of M. Bivona's description,—"Pes, plica triplici in testam retractus." On retraction, each posterior longitudinal half, bounded by the groove, is folded on its counterpart, forming two plications; then these halves are at the central depression doubled on the anterior portion, and the whole is withdrawn and covered by the operculum. Of course the routine of exsertion is exactly the converse, but it appears to me that these manœuvres are pretty much the same in all the Gasteropoda. *Scalaria*, in these and other points, is closely allied to *Murex tubercularis*, as far as external organs are considered; it only differs in having a spiral operculum instead of a muricidal one.

This creature is very free in showing its peculiarities. It inhabits the three zones. The one described was captured by myself in the middle of the littoral district, at the roots of the *Corallina officinalis*, at Exmouth, where it is of rare occurrence. I have not taken more than five or six live specimens of this species and the *S. communis* in thirty years; most of them were from the coral zone. I observed that when the animal was *in extremis*, it emitted, like the *Ianthinæ*, a brilliant purple fluid. I am not prepared to speak, at present, of the reproductive organs and the internal mechanism of the proboscis, but we may safely conclude that it does not greatly differ from the *Buccinum undatum*,—*Murex* with me. I have examined the *S. communis*, which does not vary in its organs from this species; in its colours and the disposition of its markings it exhibits some differences.

I believe the only other British species are the *S. Trevilliana*, *S. Grœnlandica*, and *S. Turtoni*. The first two I have not seen alive; the latter has been examined, but I unfortunately lost the notes. I have omitted to state as one of the

proofs of the intimate connection between *Ianthina* and *Scalaria*, that they are the only two spiral animals which copiously emit the purple fluid. Many of the *Murices* produce the purple dye, but not until the gland is punctured, when a greenish-white fluid is obtained, which becomes purple on exposure to the air.

S. COMMUNIS, Lamarck.

S. communis, Brit. Moll. iii. p. 206, pl. 70. f. 9, 10.

S. TURTONI, Turton.

S. Turtoni, Brit. Moll. iii. p. 204, pl. 70. f. 1, 2.

S. GRŒNLANDICA, Auct.

S. Grœnlandica, Brit. Moll. iii. p. 211, pl. 70. f. 5, 6.

S. TREVILLIANA, Leach.

S. Trevilliana, Brit. Moll. iii. p. 213, pl. 70. f. 7, 8; (animal) pl. F.F. f. 1–3.

The above have not been met with alive. We believe the *S. Grœnlandica* is not British.

NATICA, Bruguière.

This genus has several British species, and is one of the anomalies that are occasionally met with in every department of zoology, and which cannot enter into natural order in regular progression, but must be intercalated as excrescences, in line with the objects to which they have the greatest affinity. The present animal has alliances throughout the scale of its class. By the position of the eyes in the species that have them, and the peculiar character of the flat tentacula coalescing with the membrane of the head, it exhibits a connection with the *Eulimæ* and *Chemnitziæ*; it shows only slight connection by the operculum with the *Littorinæ*; it has also by the foot a certain affinity with the *Bullæ*; but the important organ which fixes its true position is the retractile proboscis, the invariable concomitant of the Muricidal tribes, by which this apparently ambiguous animal becomes one of the points of transition from the Holostomata to the Canalifera, and I think that it ought to enter the natural order as a member of the new family.

Authors state that *Natica* has affinity with *Sigaretus*, an exotic genus of which there is no true British species. We cannot concur in this view until the anatomy of the latter is more fully examined: if it be found to have the retractile proboscis, it will be in the same category as *Natica*, and must be withdrawn from the *Haliotidæ*.

N. MONILIFERA, Lamarck.

N. monilifera, Brit. Moll. iii. p. 326, pl. 100. f. 1; (animal) pl. P.P. f. 6, as *N. canrena*.
N. glaucina, Auct.

Animal inhabiting a spiral, globosely conical, smooth shell of 6–8 tumid volutions. The mantle, neck and body are of the palest or lightest mouse-colour; the mantle is thin, rather lax, but does not extend beyond the shell. Lamarck's commentator, M. Deshayes, says, "Le manteau se développe particulièrement sur les parties antérieures de la coquille:" this is quite incorrect; he has mistaken the upper skin of the anterior portion of the foot, which some call the mentum, for the mantle. There is no distinct head; the only vestige of one is a compressed arcuated veil which is fixed by the centre of its membrane on the anterior part of the fleshy tunic of the proboscidal sheath, and on each side by a small white muscle to the base of the groove formed by the neck and skin of the foot, at the centre of which, and under the veil between it and the inside of the front skin of the foot, the yellowish-white proboscis and the end of its inner cylinder may be seen retracted; the head-veil is shallow, sinuous, or lunated, breaking at the right and left sides, very far apart, into two moderately long, flat, triangular, pointed tentacula, red-brown on the upper and outside half, and white on the lower and inside portion, forming at the extreme angles small subcircular auricles. The eyes in this species are so excessively minute as scarcely to be detected; however, if they really exist, we know their precise position by those of *N. nitida*, in which they are very visible and immersed in the skin at the centre of the anterior base of the tentacula, on the white concealed portion, but being always covered, they appear to be of little

use as organs of vision. The foot is an enormous subcircular disk, much larger in proportion than that of any other pectinibranchous Gasteropod I am acquainted with: though of one plate, it has the aspect of being formed of four lobes; the anterior portion, by having its upper skin posteriorly and laterally disunited to form what is called the mentum, has the appearance of a distinct upper and lower lobe; so much so, that the upper one has been mistaken for and described as a large, broad head, "une tête très large et très aplatie;" but its central anterior connection with the sole shows that it is an integral part thereof. The disk, which is the third portion, is not, when the animal is in full action, greatly extended at the sides; it is posteriorly rounded, anteally somewhat constricted and more truncate, and at rest forms nearly a flat, oval, sharp-edged plateau; on this springs the operculigerous or fourth lobe, supporting on the posterior portion a semi-semicircular, yellow, corneous, paucispiral operculum, which is situated just so far from the posterior extremity as to allow the unoccupied part of that end of the lobe to reflect on and conceal it altogether from view when the foot is deployed; the operculigerous lobe is then continued on each side the cone of the shell, almost to the mentum or front skin, and forms what M. Deshayes calls "un bourrelet circulaire plus ou moins épais, dans lequel la coquille est presque entièrement cachée." This is really the case in this species, but by no means to such an extent in *N. nitida*.

On the march the upper flap of the foot is spread on the front of the shell; when at rest it is withdrawn, and forms a white rouleau that covers the lower part of the tentacula, and obscures the eyes situate at their bases, in those species in which they are not obsolete. The upper part of the anterior division of the foot is marked with fine dark, longitudinal, rather close lines or streaks; behind, it is of a pale brown or drab; the reflexed operculigerous lobe is white, and the entire disk of the sole pale yellowish-white. The animal has the power of stowing entirely out of sight the enormous foot; it does so very deliberately, and closes the aperture effectually

by placing the strong corneous operculum well within the margin; it has nothing of the rapid retraction of the foot, as in *Rissoa*.

These animals abound of large size in the Warren Sands, opposite Exmouth. When just taken, in vigour, and immersed in sea-water, it is scarcely possible to contemplate a more beautiful and interesting object, with its shell rising as a globular pyramid from an immense circular disk, elegantly marked with fine dark lines on a clear drab ground. I recommend this species for examination; its large size affords a good view of the external organs, and the anatomy is comparatively facile.

N. NITIDA, Donovan.

N. nitida, Brit. Moll. iii. p. 330, pl. 100. f. 2, 3, 4; (animal) pl. P.P. f. 5 (as *Alderi*).
N. Alderi, nonnull.

This species, as regards the external organs, is so similar to the *N. monilifera*, that a notice of the variations will suffice. It has, like its congener, two branchial plumes, and the mucous fillets are nearly as evident as in the *Muricidæ*. In the male, the organ of reproduction is in every respect more developed. The eyes are distinctly visible, immersed in the centre of the anterior bases of the tentacula. The colour of the upper front surface of the foot and tentacula is a deepish dull red-brown, which is deposited on the first-named organ in close, irregular, longitudinal streaks, but on the posterior portion they are more distant and paler coloured, and still more so laterally; the sole is a uniform pale yellow. These animals vary much in the general colour, but whatever the ground colour may be, it is modified on the particular parts as above stated.

The animal is active and not uncommon in the coralline zone at Exmouth, where, though very rarely, the pure snow-white variety occurs, as well as the plain chestnut-coloured *N. sordida*.

The following have not occurred to me alive:—

N. SORDIDA, Philippi.
N. sordida, Brit. Moll. iii. p. 334, pl. 100. f. 5, 8; (animal) pl. P.P. f. 3.

N. MONTAGUI, Forbes.
N. Montagui, Brit. Moll. iii. p. 336, pl. 101. f. 3, 4; (animal) pl. P.P. f. 4.

N. PUSILLA, Gould.
N. pusilla, Brit. Moll. iii. p. 341, pl. 100. f. 7.

N. HELICOIDES, Johnston.
N. helicoides, Brit. Moll. iii. p. 339, pl. 100. f. 6.

? N. KINGII, Forbes and Hanley.
N. Kingii, Brit. Moll. iii. p. 343, pl. 101. f. 1, 2.

LAMELLARIA, Montagu.

This genus has not more than one or two British species. The excellent Montagu, the discoverer of one of them, constituted the genus *Lamellaria* to receive it. We are bound to adopt this generic term, though *Coriocella* would have been more significant, and place in it the *L. tentaculata* of Montagu, and the *L. haliotoidea* of authors, which latter has been continually shifted from one genus to another. Both these species have, at times, been deposited by mistake in the exotic genus *Sigaretus*, after Lamarck, who had been misled by M. Cuvier having erroneously described the *Helix haliotoidea* of Linnæus as Adanson's *Sigaretus*, which has an external shell. M. Blainville expressly formed the genus *Coriocella* to receive M. Cuvier's animal, which is undoubtedly identical with the *L. perspicua*, but Montagu's appellation claims the priority as to time. As to the natural position of this genus, we must have recourse to that unerring magnet, the malacology of the animal, which consigns it to the vicinity of *Murex*. This situation, which has already been alluded to by authors, has been looked on by the older zoologists as unnatural, but, like the preceding genera, it can only be brought into the line of natural order by being deposited as an anomalous Muricidal excrescence.

L. PERSPICUA, Linnæus.

L. perspicua, Brit. Moll. iii. p. 355, pl. 99. f. 8, 9; (animal) pl. P.P. f. 1.
Sigaretus perspicuus, Cuvier et Auct.
Coriocella perspicua, Blainville.
Bulla haliotoidea, Mont. et aliorum.

Animal suboval, covered by a strong coriaceous mantle extending on all sides beyond the foot and body, with the margins plain and united, except in front, where there is a short, but decided branchial fold or canal to admit the water; the inner surface is marked with radiating white lines and flaky spots; the outer one is variable in different individuals, being often studded with bright orange or citron papillose spots, and in other cases with brown or red-brown ones. Under the skin, about the centre of the upper surface, is imbedded a white, subopake, semispiral, ear-shaped shell, which protects the branchial plume and some of the viscera. The head is a flat, smooth, very inconspicuous projection, with a subrotund orifice beneath, from whence the short retractile proboscis is exserted; at a little distance within it are two fleshy lobes supporting very thin, pale corneous plates, between which a long, flat, spiny tongue springs, which on leaving the palate forms three coils on the top of the back of the head, and is then continued to the stomach. These remarks, the result of various dissections, lead me to observe, that this short proboscis, though retractile, is not strictly of the usual Muricidal form, as in that tribe the tongue is rarely coiled; it is, however, thus contorted in our *Murex lapillus* (*Purpura* auctorum), an indisputable Muricidal animal. But in this creature, the most anomalous of our five genera, there are a host of characters to prove its close connection with the Canaliferous tribes;—it is as far from *Bulla*, the conchologist's usual depositary for animals of this sort of aspect, as the poles are from each other. Its entire, coriaceous, unreflected mantle has the decided branchial canal of many of the *Murices*, and M. Cuvier considers it the equivalent of the muricidal shell; that great naturalist, in the anatomy of this animal, thus sums up:—"En un mot, pour faire du Sigaret un Buccin, il suffirait que les tours de sa coquille moins inégaux, se prolongeassent en une

spirale plus aiguë." The tentacula arise from the short membranous awning of the head; they are long, flattened, pointed, pale yellowish-white, with large black eyes a very small distance from the bases, on extremely short offsets at the external angles, which gives them the appearance of being nearly on the bases of the tentacula. The foot is rather large and long, very little rounded in front, but deeply labiated, forming short auricles; it gradually becomes acuminated behind; it is above and below of a pale yellow. The branchial apparatus is, we believe, a single plume, crescent-shaped, which gives it the aspect of being double; it consists of about twelve vascular filaments lying on the centre of the back part of the head, under the protection of the front portion of the shield, whilst the liver and the ovarium, and in the male the testis, occupy the spiral portion. The anus opens between the mantle and the body, rather posteriorly on the left side. The verge is a spatulate organ on the right side of the neck, and is connected with the testis by a very long convoluted thread or epididymis.

These animals are sparingly taken in the summer, in the coralline zone at Exmouth; but in winter, after a gale, they are often washed up in great numbers on the Warren Sands, near the same place.

Having recently received live examples, I am enabled to state, that the branchial apparatus is a single, arcuated, light-brown plume of coarse strands, transversely placed, with the point reaching to the canal between the foot and the mantle. What Montagu calls an appendage or protruded arm from a sinus of the mantle is what has now been described; he also mentions and figures the tentacula as very short; this is not so, unless his specimen was mutilated, a very common occurrence. I have seen hundreds of live animals of all colours, but the tentacula were what would be called moderately long, and at least twice the length of those in Montagu's vignette, fig. 6.

L. TENTACULATA, Montagu.

L. tentaculata, Brit. Moll. iii. p. 358, pl. 99. f. 10; (animal) pl. P.P. f. 2.

Though the authors of the 'British Mollusca' quote me

for this species, I now believe that both it and the preceding are identical. In the great numbers I have examined during the last forty years, I have never seen one with such decidedly long, filiform, sharp-pointed tentacula as to distinguish it as a species; I think therefore we may safely conclude that Montagu's animal is the *L. perspicua*.

VELUTINA, Gray.

Velutina has a single British species: it has been thought to have a close connection with *Sigaretus*, on which point see the remarks under the genus *Natica*: in addition it may be stated, that *Velutina* has eyes, but no operculum: *Sigaretus* is the reverse; and whatever it may prove when more investigated, we shall for the present consider *Velutina* a good genus of the muricidal type; I therefore consign it to the *Peloridæ*.

V. LÆVIGATA, Auct.

V. lævigata, Brit. Moll. iii. p. 347, pl. 99. f.4, 5; (animal) pl. O.O. f.7.
Helix lævigata, Mont.

Animal suborbicular, inhabiting a brown auriform shell, with a coarsely striated thick epidermis. The mantle is extremely large and fleshy, with two emarginations, one branchial, on the left side of the centre of the shell, the other an anal conduit; it is marked in all directions with fine, intense flake-white anastomosing lines; the inflations and thick lobules of the margin can scarcely be maintained within the periphery of the aperture. The head is of Muricidal stamp, being a small, flat, almost united membrane, under which is the mouth, a mere subvertical fissure, from which the animal can exsert a long, cylindrical proboscis, annulated with fine flake-white lines; within the orifice is a small white palate, supported by two oval, yellowish-brown, striated corneous plates, between which is a very short, white, spiny tongue, which is quite anterior, not $\frac{2}{10}$ths of an inch long. The tentacula are short, white, not very pointed, and spring from the head-veil, with the eyes on slightly raised eminences

at the external bases. The foot is rather long and wide, and when extended, truncate anteriorly, with inconsiderable auricles, which in full action disappear; it then tapers to a blunt terminus. The branchial apparatus consists of two plumes, lying on the left side of the neck; the one is a pale brown riband of numerous strong striæ of vessels, the other is a small, dark, striated leaf, with an apparent division in the centre, caused by the arterial vessel; it is placed close under the larger mass. The heart and auricle are at the base of the larger leaf; perhaps the greater range may be the mucous fillets common to most or all the *Muricidæ*; but, from the position of the heart, I think both leaves are branchial. The œsophagus is extremely short; it almost immediately opens into a large oval stomach that is always filled with pulp. The œsophageal cordon consists of two oval yellow ganglia on each side, and one smaller, a little posterior to the others. The verge is yellow, not long, and is a miniature of that organ in *Murex undatus*, except that it is rather more pointed, and has the orifice at the point instead of a little below it, as in that species.

The animal inhabits, at Exmouth, the deepest waters of the coralline zone. This is the last genus which, in respect of the shell and animal, cannot be placed in a simple natural series, but must fall therein by a branch. It is not so aberrant as *Lamellaria*, as here the coriaceous mantle has vanished, and the auriform shell protecting the viscera and branchiæ has become external; nevertheless, by its thick epidermal coat it appears to supply the place of the thick external mantle of *Lamellaria*. Its place in the natural order is conspicuously marked out by the retractile proboscis as a sequence to the last genus, and it is assigned to the present family as a striking point of transition to the Canalifera.

V. FLEXILIS, Montagu.

V. flexilis, Brit. Moll. iii. p. 350, pl. 99. f. 6, 7; (animal) pl. O.O. f. 6.

This is a Scottish and Hebridean species: it appears to belong to this genus. For some account of the animal I refer to the 'British Mollusca,' vol. iii. p. 350.

The *Velutina otis* of authors, now *Otina otis*, has been deposited in this genus, but I believe its affinities are in the neighbourhood of the *Bullæ* and *Conovuli*; at the same time I admit that it requires further examination.

I now conclude; and if it be considered, "Et genus insolitum concordi lege coëgit," or, in other words, that I have applied a law—that of union—to a strange or anomalous race, and brought its members more prominently into view, my object will have been accomplished.

ALATIDÆ, Lamarck.

I introduce this family with pleasure and without hesitation to the British list, to receive a single genus with one species, commonly known as the *Aporrhaïs pes pelecani*; but this generic appellation is rejected with emphasis by M. Philippi, for his *Chenopus*. I object to both, and adopt, on account of priority, the generic title of *Rostellaria*. On what grounds both M. Philippi and the French and English malacologists have repudiated the natural position of this genus, established by Lamarck (and alluded to by the admirable Cuvier as belonging to the *Muricidæ*), and consigned it to the *Cerithiadæ*, I cannot comprehend. Philippi, in a note, says, "Animal secundum Cuvierum *Murici* simile, quod falsum est." I do not concur with M. Philippi, and will show that *Rostellaria* and the present species, as one of its members, is essentially a Muricidal animal.

The only ground for the connexion of *Rostellaria* with *Cerithium* is the muzzle; but naturalists have failed to perceive that that organ, in the true *Cerithia*, is of Rissoidean stamp, and not at all resembling that of *Rostellaria*, being broader, flatter, and differently cloven; whereas the Rostellarian muzzle is much longer, slenderer, more cylindrically tapering, and only differs from the Muricidal typical proboscis in being, by peculiar development, exsertile, instead

of retractile. It is simply cloven as in *Ianthina* and *Natica*, the cleft being rather within the margin of the buccal disk, and provided with the precise attenuated corneous plates and short tongue of the typical proboscis of the *Murex undatus*. But if malacologists think that what I have stated is not tenable, I will, though my opinion is fixed, abandon this view; I can well afford to do so, as I have in the shell, the animal, and its habitudes, more than sufficient to convince naturalists of the true position of the *Rostellaria pes pelecani*. As regards the shell, the alated processes are altogether analogous to the exotic *Rostellariæ* and *Strombidæ*, which no one disputes being peculiar developments of the *Muricidæ*. The canal of the shell also at the outer lip side of the beak, or axial process, if viewed properly, that is, with the edge to the observer, is as well marked as in those genera; and in adult shells the outer lip has a long vertical row of the same characteristic plicæ that are seen in the *Marginella lævis*, the only other British mollusk I can recollect that has them,—another strong, I may say convincing, proof that the so-called *Aporrhaïs pes pelecani* is a Muricidal animal.

As regards the animal, the operculum is absolutely Muricidal, and I challenge the most acute observer to distinguish between it and that of a *Murex Turtoni* of the same size. As for the flimsy objection of the pedicles of the *Strombidæ* being peculiar, they are nothing more than typical specific variations.

I will now allude to the locomotive habitudes of the "*Rostellaria pes pelecani*"; they are most singular, and the concordance in that respect with the exotic *Strombidæ* mentioned by Quoy and Gaimard, is perfectly irresistible as to family identity. M. Deshayes, speaking of these gentlemen, observes:—

"On sait depuis eux que le pied de ces mollusques" (*Rostellaria* and *Strombus*) "n'est plus propre à la reptation, et que l'animal, pour changer de place, est obligé de sauter, en appuyant sur l'extrémité du pied qui porte l'opercule."

ROSTELLARIA, Lamarck.

R. PES PELECANI, Lamarck.

Aporrhaïs pes pelecani, Auctorum.

———— ————, Brit. Moll. iii. p. 188, pl. 89. f. 4; (animal) pl. I.I. f. 3.

Animal occupying an elongated, alated, pale red-brown, finely spirally striated, nodosely ribbed shell of 12–14 rather tumid volutions. The mantle, of the palest fawn-colour and thinnest texture, very extensible, lax and sinuated, can be spread over the entire porcellanous area of the inside of the aperture, and lines, without becoming a produced siphon, the typical branchial canal in the outer lip, and the linear depressions of the pterygoid processes. The head is a long, cylindrical, tapering red proboscis with a yellowish flake-white margined disk vertically cloven, aspersed above with very minute yellow papillæ, and more posteriorly on the neck with irregular pink blotches, beneath white, with a few red-brown points. The tentacula are slender, of concurrent length with the proboscis, and sprinkled with pink and flake-white dots, which resolve themselves into a linear aspect at the sides; the eyes are minute, fixed on short pedicles at the external bases. The foot, when extended, is long, narrow, auricled, and contracted at one-third of the length from the front, rather lanceolate behind, but not sharp-pointed, carrying at its extremity, on a small plain oval lobe, a minute, somewhat elongated, irregular-shaped, darkish brown, horny operculum, which entirely resembles that muricidal organ. The foot is white beneath; above also white, but sprinkled sparingly with pink dots.

The locomotion is slow; but though the animal creeps, the organs do not appear adapted for progressive movement. It is very shy, and whether the shell is placed with the aperture upwards or downwards, it does not usually commence creeping by pushing out the foot anteriorly, like other Gasteropoda, but often twists the long neck and foot to the caudal extremity, and there fixing it, with a sudden spring effects the turning of the shell. I observed this manœuvre many times, and apprehend that in freedom it can only thus reverse its position.

As to the anatomy, we need only observe, that the œsophagus is very long and circled behind the proboscidal mass by a cordon of four round yellow ganglia, three above, one beneath. The liver is dark greenish-brown and very granular; the other organs, as the matrix, ovary, testis, viscous sac, anus, &c., offer no peculiarity. The organe générateur is long, yellow, strap-shaped, annulate for part of the basal portion, curving above to a point: it is not placed posteriorly, as some authors say, but under and anterior to the right tentaculum. We have omitted to state, that there is only one branchial plume, long, narrow, whitish-yellow, with about forty very short pectinations: above the plume there is a glandular substance resembling the mucous fillets of the Canalifera; or it may be a second rudimentary plume; but in either case it denotes the Muricidal alliance. Notwithstanding the anomalies of this animal, its natural position is immediately before the proboscidal groups. We think that the *Aporrhaïs pes carbonis*, lately introduced to the British list, is probably a delicate dwarf variety of the present species. It is from Zetland.

R. PES CARBONIS, Brongniart.

Aporrhaïs pes carbonis, Brit. Moll. iii. p. 186, pl. 89. f. 5, 6.
Rostellaria pes pelecani, var., Kiener.

MURICIDÆ.

I here present malacological notes on the British *Muricidæ*, which are now distributed into *Murex*, *Buccinum*, *Fusus*, *Pleurotoma*, *Purpura*, *Nassa*, *Trichotropis*, and *Cerithiopsis*; these genera form a part of Lamarck's Canalifera and Purpurifera. This family is of enormous extent, and has its origin in the Linnæan genera *Murex* and *Buccinum*, which, though separated by Linnæus on artificial grounds, have their animals identical in all essential points; and it can scarcely be doubted, with the views held by that great naturalist, that if he had been aware of their similar malacological structure, he would have merged the *Buccina* in *Murex*, or *vice versâ*. We shall therefore consider them synonymous; they have been split by the moderns into numerous genera on purely conchological

grounds. Many causes have concurred to produce this artificial arrangement;—amongst them, the multitude of species, the dissimilarity of the hard parts, which malacologists failed to see in their true light as the indices of species, choosing to consider the variable forms to proceed from generic animal distinction. We will examine these points, and endeavour to reduce them to their proper value.

The principal distinctions between this division and the Holostomata are, that the periphery of the aperture of the shells of the Canalifera is broken into branchial canals and more marked and extensive depuratory sinuses, and that the soft parts have invariably present a retractile proboscis, with some other variations that will be mentioned. The shells are of elegant structure and the animals of great beauty, but the latter resemble each other so much as only to admit, agreeably to my method, of the constitution of the single genus *Murex*, and even to render specific characters difficult without the aid of the hard parts, on which account I am obliged to enter upon more minute details than perhaps may be thought necessary. It will also be shown that the anatomy, as well as the hard and soft parts, with the general characters of the coloration, especially in the minor *Murices*, are all but identical.

There is a singular coherence in the specific descriptions; this arises from the similarity of the objects; but if, to relieve the tedium of the "iterumque, iterumque," I had attempted a generalization beyond what has been admitted, confusion would have resulted from the destruction of the individuality of the objects by amalgamated descriptive characters; the account would rather be that of a compound than of an individual animal, and the more delicate features so essential for specific comparison lost. If animals are to be described correctly, conciseness must give way to particular description; indeed, in zoological matters, the term serves for little else than to express the omission often of very essential features: but if it be insisted on, we must rest content with rough sketches instead of finished portraitures.

The general distribution of the *Muricidæ*, according to my method, includes Lamarck's Purpurifera, which have, as I

think, been separated from his Canalifera on very slight malacological grounds;—so much so, that though the commentators, in the last edition of his 'Animaux sans Vertèbres,' state that the *Purpuræ* are sufficiently distinguished from the *Murices*, I must dissent from that opinion, and challenge the production of even one essentially distinct generic character between the two families. There are about twenty-two genera which have sprung from *Murex* and *Buccinum*, whereof six or seven embrace British species, and fourteen or fifteen the exotic.

The present arrangement of the moderns appears to rest altogether on artificial generic characters derived solely from the hard parts of the animal. Conchologists have thought, that because the Muricidal animal, as I designate the *Buccinum* of authors, has a short emarginate canal, and those named *Fusus* and *Murex* have more extended ones, some of them being smooth and others varicose, they must be generically distinct animals: this is a great mistake. We are enabled to say, from a sedulous examination of the animals of all the genera, including the greater part of the British species, except the larger and deep-sea *Murices* termed *Fusi*, that they are identical in organic structure, and differ from each other in colour and slight specialties of the soft and hard parts, no more than may be observed in the different varieties of the human race: for the short man, with the short neck and inflated trunk, in comparison with the tall, thin, slender individual, does not constitute a different genus; neither is the tumid *Buccinum* or *Dolium* with the short canal, generically distinct from the more spindle-shaped *Murices*, the *Fusi* of authors. For these reasons we are bound to consult nature in preference to artificial considerations.

The animals of all the modern genera of the Canalifera and Purpurifera, the proceeds of the dismemberment of the genera *Murex* and *Buccinum*, are zoophagous, and have the flat proboscidal head, which is rarely produced so as to intercept the basal coalition of the tentacula, which carry eyes externally at different portions of their lengths. The buccal fissure is at the centre of the tentacular veil or head, placed somewhat inferiorly; from this a long retractile proboscis is exserted,

armed with hard parts of variable lengths for boring and sucking their prey. They all have the double branchial plume, mucous fillets, and more or less long branchial fold; the stomach, liver, heart, auricles, ovarium, testis, organe générateur, and nervous ganglia, in short, the entire internal anatomy scarcely differs. The variations are specialties of small value, as the size and outline of the foot and its operculum, the different distances of the pediculated eyes from the base of the tentacula, and the variations in the external markings and contour of the hard parts; with respect to which we may observe, that they arise solely from the varying disposition of the mucous glands of the mantle, combined with the variety of food and habitat: but we think such differences do not constitute generic distinction.

Conchologists will ask, if the present numerous genera of this family are merged in the single one of *Murex*, how are they to distribute the multitudinous species? The only answer is, not by dividing the simple genus into twenty others of similar characters. If the genera of these gentlemen are intended only as aids for the arrangement of vast numbers of species, such symbols might be accepted, though objectionable as to appellation, because, without explanation, they would convey ideas of generic distinction rather than of divisional assistance; it is therefore better to consider the variations of form and markings as simple sectional guides to reduce an enormous family to comparatively easy identification of its species. It is a very illogical position, that because a genus happens to have a thousand species or more instead of ten, it is on that account to be cut up into numerous genera, which are absolutely misnomers, being without generic distinction. For these reasons I shall consider all the British Canalifera, and such of Lamarck's Purpurifera as comprise any of our indigena, as represented on malacological grounds by the animal of the ancient genus *Murex*, dividing the species into specific groups by the marked variations of the forms and sculpture of the shells, and by sectional indices and definitions.

If, however, malacologists will not dispense with the old

names *Buccinum, Fusus, Purpura, Nassa,* &c., they must follow the bent of their inclination; it is hard to cast off old habits, even though much better ones may present themselves, "meliora probo, deteriora sequor:" but in our method they will bear in mind that these words have the precise value of our sectional definitions: they are mere signs and mementos representing objects with certain outward characters, but without the *slightest generic pretension.*

It may be objected that our sections and definitions are the mere equivalents of the old *Buccinum, Fusus,* &c.: this is not so; these terms pretend to represent what does not exist—generic distinction; but the sections merely point out variations of external aspect to assist arrangement: the first stalk abroad under false colours, the others are clothed in simple integrity, casting off the garb of phrases which imply fictitious values.

The generic synonymy appended to the sections will enable the collector to arrange his objects, either in the groups of the Linnæan *Murex,* or in the pseudo-genera of the moderns. The following seven sections will suffice for our Muricidal indigena. The exotic objects will require a few others.

MUREX.

Murex et Buccinum, Linnæus.

Sectio I.—*Testa conica, subinflata, varicosa, spiraliter striata. Canalis effusus, sæpe obtectus. Apertura ovalis. Columella aspera. Operculum corneum.*

Murex, Auct., Pleurotoma, Lamk., Trophon, Montf., Lachesis, Risso, Mangelia (*pars*), Leach and Forbes.

M. erinaceus, Linnæus.

M. erinaceus, Brit. Moll. iii. p. 370, pl. 102. f. 4; (animal) pl. T.T. f. 1.

Animal spiral, yellowish-white; mantle very thin; the branchial fold extends very little beyond the canal of the shell. The head is small and compressed; from its angles the moderately long tentacula spring, and almost coalesce at their bases, from which they run tumid to some distance, accompanied by offsets of more than half their length, on

which the eyes are placed externally; from thence the tentacula taper conically to their extremities. The mouth is a vertical fissure beneath the tentacular veil, and emits the characteristic proboscis. The foot when quiescent is nearly oval, but on the march is truncate in front, throwing off on the right and left small auricular points; it is gently constricted medially, and has a blunt rounded termination, carrying on the posterior upper surface an elongated, red-brown, corneous, unguiculated operculum.

Lamarck's commentators say, that between the genera *Murex* and *Purpura* there are sufficient marks of distinction, and, in support of this opinion, they adduce the truncation of the tentacula at their offsets in *Purpura*, which they state is more apparent than in *Murex*. We dissent from these views, and think the distinction is purely ideal—at least it is so in the species of each genus we have examined: the fact is, that when the tentacula are collapsed, the basal two-thirds appear very tumid and broad at the termini of the offsets, but in fully extended action the truncation nearly or altogether vanishes, and no peculiarity is apparent at these points.

It will be observed below, that the external organs of *Murex lapillus*, the *Purpura* of authors, are nearly identical with those of *M. erinaceus*, and the internal organs of the two are so similar, that it would be a repetition to describe them. The corneous opercula scarcely show distinction; that of this species may be generally of a deeper red, and somewhat rounder, though the arches of the striæ are not less elliptical. The gland producing the purple dye is as conspicuous as in *M. lapillus*; indeed this gland may be traced in all the Canalifera, though its secretion varies in colour; there may also be a slight difference in the lingual riband, which is here rather longer and more coiled than in its congener, and the cerebral ganglia are smaller: but these variations are of little value. The different hues of brown in *Murex erinaceus* form the ground colour, but are invariably mixed with white or flaky-yellow markings on the upper part of the foot and on the tumid portion of the tentacula, the conically-pointed upper parts being of a uniform colour; the under part of the foot is

bordered by a narrow band of flake-white transverse filaments. These distinctions in the coloration are constant.

This species inhabits the littoral, laminarian, and coralline zones at Exmouth in abundance. It may be asked, what are the causes that animals with such decidedly similar organs as the *Muricidæ*, should produce shells so entirely dissimilar? The answer is, that there are certain variations in the form and disposition of the vessels of the mantle for the secretion of the calcareous and colouring matters, which, although inappreciable, are the agents that effect the diversity of structure, sculpture, and marking.

M. MURICATUS, Mont.

Trophon muricatus, Brit. Moll. iii. p. 439, pl. 111. f. 3, 4; (animal) pl. S.S. f. 5.

Animal of seven or eight spiral volutions, of a pure white ground interspersed sparingly in some specimens with minute flakes of a more intense white. The mantle is even with the aperture, except that it is prolonged into a branchial fold, often extending beyond the canal of the shell. There is no emargination in the upper part of the outer lip of the shell, but only a small incipient duct, which is lined by a corresponding extension of the mantle. The head shows no trace of a muzzle. The tentacula coalesce, as in the strict *Muricidæ*; they are pointed and rather long in proportion to the minute size of the animal, with the eyes on thick offsets at about half their length. The buccal orifice is a central vertical slit, and exserts a retractile proboscis. The foot is of moderate length, a little curved anteally, forming at its right and left points minute auricles, and tapering gradually to an obtusely pointed termination, on which, at the upper surface, is a light, horny, suboval and subunguiculated operculum.

This beautiful species is taken abundantly alive at Exmouth in the deepest waters of the coralline zone; it is almost always enveloped in an orange-red spongy mass, which doubtless serves as a mantle of concealment and protection, like the earthy coating of the terrestrial *Bulimus obscurus*.

M. SEPTANGULARIS, Mont.

Mangelia septangularis, Brit. Moll. iii. p. 458, pl. 112. f. 6,7; (animal) pl. T.T. f. 3.

Animal with eight spiral turns, white in all parts, powdered with more intense minute flake-white points. Mantle rather thick at the edges, and produced into a fleshy branchial fold that extends beyond the short canal of the shell. The head is compressed, narrow, with a vertical fissure below it, from which a retractile proboscis issues. The coalition of the tentacula at their bases is not in the least impeded by any projection of the head; they are short, setose, with the eyes on attached thick offsets at the external points, at about two-thirds of their length; the remaining portion is very short. Foot rather narrow, slightly auricled, truncate in front, moderately long, with the termination nearly as broad behind as in front, without a trace of a distinct point, though it is often more or less emarginate; it carries on the upper part a strong, very elongated, oval, pale corneous operculum formed of unguiculated segments. The sinus or emargination at the upper part of the aperture is very slight.

This species is not often obtained alive at Exmouth; its range of habitat is from the littoral to the coralline zone. It has by some authors been deposited in *Pleurotoma*,—on what grounds can scarcely be satisfactorily explained, as the emargination is almost obsolete, or less conspicuous than in any other of the minor so-called *Pleurotomata*; besides, as has been stated, the head is perfectly flat, without a trace of projection to intercept the coalition of the tentacula. We consider it in every respect a varicose *Murex*.

The following have not been seen by me alive :—

M. CORALLINUS, Scacchi.

M. corallinus, Brit. Moll. iii. p. 374, pl. 102. f. 5, 6.

M. BARVICENSIS, Johnston.

Trophon Barvicensis, Brit. Moll. iii. p. 442, pl. 111. f. 5, 6; (animal) pl. S.S. f. 4.

M. CLATHRATUS, Linnæus.

M. Bamffius, Auct.

Trophon clathratus, Brit. Moll. iii. p. 436, pl. 111. f. 1, 2; (animal) pl. S.S. f. 3.

M. MINIMUS, Montagu.

Lachesis minimus, Brit. Moll. iii. p. 376, pl. 101. f. 7, 8.

The *Triton elegans*, Brit. Moll. vol. iii. p. 443, is exotic.

Sectio II.—*Testa inflata, lævis, spiraliter striata. Canalis effusus, plus minusve elongatus. Apertura ovalis. Columella mutica, rarius subaspera, aut fastigiata. Operculum corneum.*

FUSUS, Lamarck et Auctorum.

The *Murices* of this section are the *Fusi* of authors, most of which are deep-sea species, as the *M. antiquus*, *M. Turtoni*, *M. Norvegicus*, *M. Berniciensis*, *M. Islandicus*, &c., and the *M. borealis*. None of these, except the *M. Islandicus*, occur on the southern coasts, and that we have had no opportunity of examining for several years; but for the type of the animal of the enumerated species, we refer with perfect confidence to either of our descriptions of the *M. erinaceus*, *M. lapillus*, *M. undatus*, or any other in our list, which will furnish every essential generic character; and I fully expect to have it in my power, by the examination of live specimens of *M. Islandicus*, to show the correctness of their assigned position as members of the genus *Murex*. I can say nothing of the animal of *M. borealis*, which is admitted here as probably belonging to this section.

M. BOREALIS, Broderip.

Trichotropis borealis, Broderip et aliorum.

———— ———, Brit. Moll. iii. p. 361, pl. 101. f. 5, 6; (animal) pl. I.I. f. 1.

M. ANTIQUUS, Linnæus.

Fusus antiquus, Brit. Moll. iii. p. 423, pl. 104. f. 1, 2.

M. TURTONI, Bean.

Fusus Turtoni, Brit. Moll. iii. p. 431, pl. 105. f. 3, 4; pl. 106. f. 2, 3, 4.

M. NORVEGICUS, Chemnitz.

Fusus Norvegicus, Brit. Moll. iii. p. 428, pl. 107, & pl. 108. f. 7, 8, 9.

M. BERNICIENSIS, King.

Fusus Berniciensis, Brit. Moll. iii. p. 421, pl. 105. f. 1, 2. & pl. 106. f. 1.

M. Islandicus, Chemnitz.

Fusus Islandicus, Brit. Moll. iii. p. 416, pl. 103. f. 1, 3; (animal) pl. S.S. f. 2.

M. propinquus, Alder.

Fusus propinquus, Alder.

—— ——, Brit. Moll. iii. p. 419, pl. 103. f. 2; (animal) pl. S.S. f. 1.

Notwithstanding the variation in the apex of *M. Islandicus* and *M. propinquus*, their distinctness may be doubtful.

Sectio III.—*Testa inflata, varicosa vel lævis, sæpe spiraliter granoso-undato-striata. Canalis brevis. Apertura ovalis. Columella fastigiata. Operculum corneum.*

Buccinum, Auctorum.

M. undatus, Linnæus.

Buccinum undatum, Brit. Moll. iii. p. 401, pl. 109. f. 3, 4, 5; pl. 110. f. 4; (animal) pl. L.L. f. 5. et omnium Auct.

B. Humphreysianum, Bennet, et Brit. Moll. iii. p. 410, pl. 110. f. 1.

Animal with eight spiral turns, of a pale yellow ground colour in all parts, sparingly interspersed with irregular dark blotches on the upper part of the foot, the tentacula, and branchial fold. The mantle is of thin texture, and no portion of it extends beyond the shell, except the branchial fold, which when in action floats far beyond the emargination of the shell, for only slight traces of a canal remain. The head is small, compressed, not at all produced, and does not in the least interfere with the coalition of the tentacula at their bases; these are long and flattish, broad at their origins as far as the eyes, which are placed on shortish external offsets, and the remaining portion terminates in rounded but not pointed extremities. The mouth is a vertical central fissure rather below the surface of the head, and from it a very long and powerful proboscis is exserted, armed with the usual spinous tongue. The foot is large, broad, and about as long as the shell, slightly auricled and curved in front, and rounded posteriorly to an obtuse point; on its upper part it carries a comparatively small, but strong, light corneous, suboval operculum, having the striæ of increment of the same form, with the nucleus about the middle of its outer edge. There are

two branchial plumes, one very large and pale brown, the other small, linear, of a darker brown. We say nothing of the internal organs, as it has already been stated that they are identical throughout the Muricidal tribe. We refer those who wish to see a full account of the internal structure of this animal, to Baron Cuvier's 'Mémoires pour servir à l'Histoire des Mollusques,' where they will find an elaborate account and delineation of it. This celebrated animal may be regarded with perfect confidence as a faithful type of the entire Muricidal division; our descriptive notes of the various animals will fully confirm this view.

Having taken the bold step of merging one of the classic genera of Linnæus and authors in the genus *Murex*, I must say a few words by way of justification. I am prepared to have much obloquy heaped on me for my presumption, but I shall enter on no defence beyond the present observations, leaving it to the unerring critic, Time, to pass sentence on the step I have taken. I will now only observe, that I have as much right to suppress, on what I consider to be just grounds, a Linnæan genus, as others have to split one into twenty genera; and I am confident that if the great and candid Linnæus had known as much of the animals of the *Murices* and *Buccina* as the progress of science has since made known, he would have merged one or the other of these genera: no conscientious naturalist can support both, the animals being identical in all essential points. I have preferred to retain *Murex* as the representative of the most extensive group, and by far the older genus. The British *Murices* of this group are very few; we have only examined the *M. undatus*.

The animals of the following species have hitherto escaped detection:—

M. Dalei, Sowerby.

Buccinum Dalei, Sowerby.

——— ——, Brit. Moll. iii. p. 408, pl. 109. f. 1, 2.

M. fusiformis, Broderip.

Buccinum fusiforme, Broderip.

——— ———, Brit. Moll. iii. p. 412, pl. 110. f. 2, 3.

We have obtained a fine series of the shells of the *M. Humphreysianus*, and believe it to be a smooth variety of this most variable species. The *Buccinum acuminatum* of authors is generally considered a flat-whorled variation of the "*undatus*;" at present we accept that position, though with some doubt, on account of the peculiar compressed character of the volutions in the three examples we have examined. The animal must decide the question.

Sectio IV.—*Testa tumida, lævis, sæpe spiraliter substriata. Canalis obliquo-dorsali-brevissimus. Apertura ovalis. Columella dorso-fastigiata. Operculum corneum.*

Purpura, Lamarck et Auct.

M. lapillus, Linnæus.

Buccinum lapillus, Montagu.
Purpura lapillus, Lamarck et Brit. Moll. iii. p. 380, pl. 102. f. 1, 2, 3; (animal) pl. L.L. f. 4.

Animal spiral, of a uniform pure white or pale yellow, without the intermixture of other colours or markings, except a single superficial fine longitudinal line of deeper hue, which divides the under part of the foot into two portions. The mantle is of very thin texture, lining the shell only to the margin, except the part constituting the branchial fold, which is occasionally carried, in marching, a little beyond the short canal. The head is very small, slender and flat; from this spring the moderately long tentacula, which are tumid and rounded from their bases, accompanied for two-thirds of their length by offsets on which the eyes are placed externally, and from thence running conically to not very pointed terminations; the mouth and its vertical fissure, from which a short proboscis is very rarely seen protruded, are beneath. The foot when at rest is nearly oval, but in action it is truncate and auricled in front, somewhat attenuated in the middle, and has a rounded termination, with, on its posterior upper surface, an irregular oblong, red-brown, corneous, subunguiculated operculum, having the lines of increment raised on the inner surface. The buccal mass, as in all the *Murices*, lies within

the proboscis, which itself is enclosed in a case, and consists of two pale fleshy lobes, supported by very thin corneous plates, between which the tongue is fixed, and after passing the extent of the proboscidal tube, it forms a coil of four or five turns, immediately behind its posterior part; it is narrow, white, spiny, and about half an inch long; under the coil is the cerebral cordon embracing the œsophagus, formed of about eight suboval yellow ganglions. There are two branchial plumes, one large and pale brown, the other minute, linear, and of a much darker hue; they have the arterial vessel in the centre, and are fixed as in the congeneric species; then are seen the mucous fillets which furnish the material for the capsules of the ova: the rectum and ovarium, with the canal of the viscous sac, debouche on the right side. The stomach is enormous, and always found filled with a tenacious mass of pulp; the ovarium is yellowish-white, mixed up with the liver, which is of a dark brownish-green, occupying, with either the ovarium or testis, the posterior whorls of the shell to the apex. The sexes are distinct: the male organe générateur differs from the ridged, grooved, spatulate and double-pointed appendages of some of the *Murices*, in being smaller, flatter, less pointed and more strap-shaped. This detailed account of these organs will not be repeated, as they are essentially the same in all the *Murices*.

This section, I believe, contains only the British species now described. It is common everywhere, and rarely extends its habitat beyond the littoral zone.

Sectio V.—*Testa tumida, granuloso-plicata vel lævis. Canalis obliquo-dorsali-brevissimus. Apertura ovalis. Columella striata, in plicam intorta. Operculum corneum.*

Nassa, Lamarck et Auct.

M. reticulatus, Linnæus.

Buccinum reticulatum, Montagu.
Nassa reticulata, Lamarck et Brit. Moll. iii. p. 388, pl. 108. f. 1, 2; (animal) pl. L.L. f. 3.

Animal spiral. Mantle of very thin texture, not extending beyond the aperture, except that portion of it styled the

branchial fold, which in adult specimens is often exserted an inch beyond the emargination of the shell; it floats free, as there is no canal for its support; it is also evidently a tentacular aid.

The colour of the upper part of the foot, of the tentacula as far as the eyes, and of the branchial fold, is a light brown ground, so thickly studded with yellow flakes and minute dark points and blotches, as to give the animal a dark pepper-and-salt aspect; the under part of the foot is yellowish-brown, aspersed with very minute dark points. The head is small and flat, with two long tentacula, bearing eyes externally on offsets about a quarter of an inch from the bases, where they are wide, but from thence to their termination they become slender and pointed. The foot is very large, long and broad, extending, when in full march, more than the length of the shell; it is bevelled to a fine edge, gently rounded, indented in the centre in front, and has slightly curved, rather long auricles; it then gradually declines to an elongated lanceolate termination, which is emarginate, and sends forth from each fillet of the fork a pointed filament: close and anterior to the caudal emargination is a brown, corneous, suboval, subunguiculated operculum. I have thought that the emargination might be the seat of a gland, as that part is constantly covered with mucus, which, when removed, recurs; but as I could trace no distinct duct, I presume the exudation is of porous origin. The mouth is a vertical fissure under the head, from which a very long proboscis is protruded, the structure of which is in all respects similar to that of *Murex undatus*, mihi (*Buccinum undatum* auctorum), as are the cerebral ganglia, the salivary glands, the double branchial plumes, the mucous fillets, and the heart and auricle; all these organs I have dissected and compared with the same parts of that species, without finding any essential differences.

It appears from these notes, that the principal variations of this section of the Muricidal group from its fellow-species, consist in the large size and somewhat varied outline of the foot with its caudal filaments; but surely no malacologist will contend that these are generic distinctions: the whole of the animal must be taken into view, and this will undoubtedly,

with all disinterested naturalists, stamp it as a true member of the genus *Murex*. The animal is lively, active, not at all shy, and marches with rapidity; it inhabits in great abundance the littoral and laminarian zones. It must be regarded as the type of the British species of this section; it has the most intimate and congeneric alliances with the animals of the third and fourth sections.

M. INCRASSATUS, Müller.

Buccinum macula, Montagu.
Nassa incrassata, Auct. et Brit. Moll. iii. p. 391, pl. 108. f. 3, 4; (animal) pl. L.L. f. 1.

Animal spiral, of a pale dirty-yellow throughout, marked irregularly on all its organs with small dark lead-coloured or brown dots, lines, or blotches. The branchial fold of the mantle extends far beyond the short canal, and though cloven, forms apparently an entire cylindrical tube, which is constantly in motion and used as a tentacular organ. The head is pale red, with a vertical fissure, from which a long proboscidal trunk issues. The tentacula are not long, but thickened from their bases to half the length, at which point the eyes are fixed at the internal angles; from whence they taper to slender conical points. The foot is truncate anteriorly, indented in the centre in front, and curving right and left into pointed auricles; when extended it is longer than the shell, and tapers posteriorly to a flat, bevelled, emarginate terminus, with scarcely a trace of caudal filaments; the operculum is corneous, of suboval shape, and shows the subunguiculated striæ of increment. There are two semilunar branchial leaves, one much larger than the other, with dark brown transverse vessels, connected with the mantle and neck in the usual manner; the heart is a pale, minute, subcircular inflation, situate immediately behind the branchiæ. The male has on the right side the ordinary spatulate organe générateur, and the testis, which is paler than the ovarium, is substituted for that organ; in the female the ovarium is large, of a deep maroon-red, mixed up with the pale brown liver, and fills the three terminal volutions.

The animal displays very energetic locomotion; it inhabits, at Exmouth, all the sea zones abundantly.

M. PYGMÆUS, Lamarck.

Nassa pygmæa, Brit. Moll. iii. p. 394, pl. 108. f. 5, 6; (animal) pl. L.L. f. 2, as *varicosa*.

This species has been considered a variety of the preceding; it is closely allied to it, but the animal and shell sufficiently indicate specific distinction. To describe it in the entirety would be a useless repetition; I therefore only note the deviations from its congener. The animal is more slender, and invariably of much lighter colour; and in addition to the simple emarginate termination of the foot in the *M. incrassatus*, there are here two long, pointed, apparently tentacular filaments issuing from the fillets of the caudal fork; these are the only material differences. But in this case the shells of the two present so distinctive a contour as to corroborate the malacological variations: that of the *M. pygmæus* is of much more elegant form, being more produced, the volutions rounder, with additional cancellated ribs, which are not undated, and displaying the white varices (from two to five) of former apertures, which in this species, in fine fresh specimens, are of purple colour; in *M. incrassatus* the apertures are rufous-brown.

This animal, at Exmouth, only inhabits the coralline zone, and is much rarer than the *M. incrassatus*; it is very lively, and submits to the closest examination. We have kept separate assemblages of the two species for days; we believe they are distinct.

Sectio VI.—*Testa conica, elongata, gracilis, turrita, granuloso-plicata. Canalis obliquus, brevis. Columella recta et lævis. Operculum corneum.*

CERITHIUM, nonnull. CERITHIOPSIS, Forbes.

M. TUBERCULARIS, Montagu.

Cerithiopsis tubercularis, Brit. Moll. iii. p. 365, pl. 91. f. 7, 8; (animal) pl. O.O. f. 1 & 2, and pl. 103. f. 6.?

Animal inhabiting a spiral shell of 10–15 volutions, flake-white, except some sulphur-coloured points behind each

eye; behind these, on each side the neck, is a longitudinal band composed of minute brown points, and anterior to the operculum two sulphur-coloured patches, one on each side. The head is small, compressed; mouth a vertical fissure in the centre of the fork between the tentacula, from whence, as in the Canalifera, a retractile proboscis is exserted. The tentacula are short, inflated, subrotund, slightly triangular at the bases, and for the terminal part flat and more slender, blunt or very little clavate at the tips; they are frosted hyaline, and edged throughout all the margins with hair-like lines of a more intense white, giving them a very elegant appearance; the foot is also bordered in like manner. The mantle forms a branchial fold, which does not float beyond the canal of the shell, and it also lines the slight sinus at the upper angle of the aperture. The eyes are comparatively close together, rather large, immersed exactly in the centre of gently raised subrotund inflations. The foot in front is scarcely auricled at the external angles, square, with a shallow groove dividing the sole in front from the upper lamina, and forming slight labia; it is gradually constricted in the middle, tapering to a moderately pointed termination, with a very deep central longitudinal groove in the posterior half of the foot, terminating at its centre in a minute deep cavity, which undoubtedly pierces the integuments, and appears to communicate with the interior of the foot at its junction with the body.

This decided cavity and the very deep scission are in some measure new features; they are either to act as aquiferous canals, or to allow the posterior half of the foot to fold, and thus assist its doubling at right angles. Though medial grooves in the foot of the Gasteropoda are not unusual, I have never met with one like this. The foot is usually carried in advance of about half the length of the tentacula, but during great exertion is sometimes produced to their tips. There is a distinct margined operculigerous lobe without wings or caudal appendages, on which is fixed a very light horn-coloured, subrotund, corneous operculum at some little distance from the termination of the pedal disk; this is marked with the usual characteristic striæ of increment of the Muricidal oper-

cula. I can say nothing of the branchial plume and reproductive organs, being unwilling to make a perhaps useless attempt to see them by the destruction of the beautiful specimens.

This very elegant creature inhabits the middle levels of the littoral zone at Exmouth, in quiet sheltered pools amongst the minor Algæ, in company with the *Cerithium reticulatum*, (our *Rissoa vulgatissima*,) which outnumbers it by fifty to one. With it is also rarely found the *Murex adversus* of authors, which we believe, when the animal is seen, will prove to be congeneric with *Rissoa vulgatissima*. When our present animal is just captured it is very lively, and creeps up a glass quickly.

There can scarcely be a greater contrast than between this animal and that of the *Rissoa vulgatissima*, with which it has hitherto been confounded, and which has the entire aspect of an elongated *Rissoa*, whereas our *Murex tubercularis* is an undoubted Canalifer, though it has evident relations with *Eulima* and *Chemnitzia* by the position of the eyes and shape of the tentacula; still the balance of characters is greatly in favour of the present position. I believe Mr. Alder and myself are the first and nearly contemporaneous observers of this species.

We believe the *Cerithium metula* of the 'British Mollusca' is congeneric with *Murex tubercularis* above. But it is possible it may not be a muricidal animal: if so, it will probably fall into the section of the elongated *Rissoæ*.

? M. METULA, Lovèn.

Cerithium metula, Lovèn.

———— ————, Brit. Moll. iii. p. 198, pl. 91. f. 3, 4.

Sectio VII.—*Testa gracilis, fusiformis, plicata, spiraliter striata. Canalis effusus. Apertura subovalis, labio externo plus minusve emarginato. Columella planato-substriata. Operculum nullum.*

MANGELIA, Leach, Forbes and Hanley.

M. GRACILIS, Montagu et auctorum.

Mangelia gracilis, Brit. Moll. iii. p. 473, pl. 114. f. 4; (animal) pl. R.R. f. 8.

Animal spiral; ground-colour white, aspersed throughout

all the organs with intense-white flakes, mixed nearly equally with pink lines, points and blotches; these are minute, though varying in size and irregularly distributed. Mantle rather thick, not extending beyond the margin of the aperture, except the branchial fold, which is often carried considerably beyond the canal of the shell; it also forms in the outer lip, at the upper part, a small, open, slightly produced conduit that lines a deep scission in that part of the shell. This species is one of the most typical of the *Pleurotomata* of British authors, but its distinguishing feature, the sinus, is not sufficiently stable in the British species to give them the impress of generic distinction.

The head is a short red protrusion, vertically cloven, evolving a long proboscis; it contains the usual short spiny tongue and other organs of the buccal apparatus; consequently in this species the tentacula do not completely coalesce basally. The want of conjunction of the tentacula at their bases is the character principally relied on by those malacologists who contend for a generic distinction between the so-called *Fusus* and *Pleurotoma*; but this character as regards the British *Pleurotomata* is very variable and cannot be depended on, as some decided ones have not a trace of an exserted head or veil, and have their tentacula conjunctive at the bases, with only the separation of the proboscidal fissure; and in the genus *Fusus* the same discrepancies occur, as in some of the minor species the tentacula coalesce, whilst in others the conjunction is slightly intercepted by the scarcely appreciable appearance of a head or head-veil. The tentacula in the present animal are short, with eyes on the external extremities of offsets which extend within a very short distance of their points. The foot at rest is beautifully puckered; when in action it is truncate in front, with small auricles, flat, long, acuminated behind, and extending to the fourth volution from the base. There is not a trace of operculum: it is difficult to account for the absence of this appendage; it may be surmised that the apertures of these shells are so narrow as not to require such a protection, but this argument cannot be relied on, as we see that the *Aporrhaïs pes pelecani* has a corneous

operculum with a still narrower aperture. The branchiæ are semilunar, one large, one smaller, of a dark brown colour; immediately above the larger one are the coarse pale yellow mucous filaments, which are edged with a dark border. The organe générateur mâle is a very long, narrow, strap-shaped appendage, pointed at the end, springing under the right tentaculum, and lying doubled up and reflected back in the branchial cavity. The ovarium and liver occupy all the posterior volutions, and run mixed together to near the pylorus; the two organs are easily distinguished, the ovarium being pale yellow, and the liver red-brown. In the male the testis replaces the ovarium. I have a little exceeded the limits of ordinary description on account of this animal being the type of the section.

This elegant species is sufficiently abundant in the coralline zone at Exmouth.

M. Ginannianus, nobis.

Pleurotoma Ginannianum, Philippi, Moll. Sicil.

Mangelia nebula, Brit. Moll. iii. p. 476, pl. 114. f. 7, 8, 9; (animal) pl. R.R. f. 7.

Animal spiral; ground-colour white or pale yellow. Mantle plain, even, except the branchial fold, which, when the animal is in motion, floats freely beyond the canal, and from its constant movement appears to act as a feeler; the mantle also at the upper part of the outer lip lines a very inconspicuous emargination of the shell, forming a minute anal conduit. The head is small, white, compressed, and does not at all interfere with the basal conjunction of the tentacula; the proboscidal fissure, as in *Murex undatus*, is below the coalescing membrane; the tentacula are short, flake-white, with eyes at the terminal surface of external offsets nearly extending to their points. The foot, when fully extended, reaches to the third or fourth posterior volution; it is pale yellow below, with marginal transverse white markings, and sprinkled on the upper surface with intense flake-white spots; it is subrotund in front, scarcely auricled, narrow, gradually tapering to a blunt, slightly emarginate point. There is no operculum, and in this respect and in all the other organs it agrees with *Murex gracilis*. This

is the "rugged form" of the *M. nebula* of the 'Brit. Moll.' vol. iii. p. 477:—fig. 7. of pl. 114 is this form and our *M. Ginannianus*.

I might have generalized in this species, but I am obliged to give a somewhat more detailed account of it than usual, as it is the standard of comparison with the two next species, with which it has been considered identical by some conchologists.

I have myself dredged this species in the laminarian zone off Budleigh Salterton. A larger variety is taken occasionally in the deeper waters of the coralline zone, which I am inclined to think may turn out a distinct species. It appears in 'Brit. Moll.' vol. iii. p. 478, as var. *pyramidata* of *Mangelia nebula*. The organe générateur is precisely similar to that of *Murex gracilis*.

M. NEBULA, Montagu.

Mangelia nebula, Brit. Moll. iii. p. 476, pl. 114. f. 7, 8, 9; (animal) pl. R.R. f. 7.

This animal has the closest alliance with *M. Ginannianus*, therefore only the very doubtful and almost inappreciable variations will be mentioned. In this species the eyes appear larger and the tentacula proportionately shorter than in *M. Ginannianus*. The general aspect of the shells of the two species appears to afford even better specific distinctions than the animals. In August 1849, I dredged in Littleham Cove, near Exmouth, in the laminarian zone, several specimens both of the *M. Ginannianus* and *M. nebula* at the same haul; they proved lively and afforded a good examination for some hours; and the differences between them with respect to the shells are, that the *M. Ginannianus* is less slender, the aperture more patulous, and the colour of a uniform yellow, whilst that of *M. nebula* is much darker, and shows a still darker spiral band in the sutures. The animals also differ: the *M. Ginannianus* has the ground colour of a very pale yellow-brown, suffused with a tinge of light red, and the flakes with which the whole body is aspersed have a light sulphur tinge; whereas in *M. nebula* the ground

colour is pale yellowish-white, shot with slight hues of red, and the flakes are snow-white. These differences are certainly not very important, but they do not appear to depend on food and habitat, and they are constant in the two species; I am therefore rather inclined to think that there may be sufficient grounds for specific distinction. There is no trace of operculum, and in other respects they closely agree with the type, except that here the pleurotomic sinus is very inconsiderable. This is the var. *lævigata*, 'Brit. Moll.' vol. iii. p. 478:—figs. 8, 9 of pl. 114 are this form and our *M. nebula*.

A further examination of the *M. Ginannianus* and *M. nebula* induces us to consider them distinct; and as far as a shell examination is available, we think the large var. *pyramidata* of the 'Brit. Moll.' is also distinct. There is no figure of this form; it is twice the size of either of the other varieties, and is as rare as the others are common.

M. BRACHYSTOMA, Philippi.

Mangelia brachystoma, Brit. Moll. iii. p. 480, pl. 114. f. 5, 6; (animal) pl. R.R. f. 2.

The *Pleurotoma brachystomum* of Philippi, recorded in the 2nd vol. p. 169 of the 'Enumeratio Moll. Siciliæ,' appears to be distinct from *M. Ginannianus*, judging from the characters of the shells, which exhibit greater distinctive marks than the animals. We have examined the two alive, and the only perceptible difference is in the colour, which in this species is pure hyaline, without the least effusion of the pale red or yellow-brown which is apparent in *M. Ginannianus*; and the snow-white flakes on the upper part of the foot are very distinct, and do not run into each other as in its congener.

At Exmouth the two are taken together in the coralline zone. The *M. Ginannianus* also occurs commonly in the laminarian zone in company with *M. nebula*, but in that habitat we never met with the *M. brachystoma*. It must be admitted that the specific distinctions between these species are even less important than those between *M. Ginannianus* and *M. nebula*; the shells exhibit some distinctive characters,

but the animals are nearly identical, consequently we are bound to consider the animal diagnoses of preponderating value, and pronounce the two to be varieties of the same species.

M. LINEARIS, Montagu.

Mangelia linearis, Brit. Moll. iii. p. 470, pl. 114. f. 1, 2, 3; (animal) pl. R.R. f. 6.

Animal spiral; the colour throughout is of a uniform brilliant frosted white, occasionally suffused with snow-white opake matter. The mantle is simple, being only produced into a simple branchial duplicature lining the canal of the shell, and, as in its congeners, often extending beyond it. The head is very short, flat, forming a sort of head-veil, under which the usually armed proboscis issues; consequently the tentacula do not form a completely conjunctive angle at their bases.

I should have been glad to have seized and admitted such a character as generic, in default of a better, to separate the *Pleurotoma* and *Fusus* of authors, but I found the character not constant, and that some of the more decided *Pleurotomata* have the complete conjunctive tentacula, and not a trace of head or head-veil, but merely the intervention of the usual vertical buccal orifice. I am therefore compelled to relieve the genus *Murex* of these modern dismemberments. I feel confident that none of the so-called British *Pleurotomata* or *Fusi* differ generically from *Murex*. Some of the exotic species may perhaps afford better distinctive generic indices.

The tentacula are long, and taper to a fine point, having the eyes at the external angles of pedicles of not half their length. The foot in front is subtruncate, acutely auricled and labiated; when in action it is sinuated, long, narrow, tapering to a fine point, and, when fully extended, reaches beyond the posterior end of the spire. It is the only species I know of, except the *M. costatus*, that shows this peculiarity. There is no vestige of an operculum, and the lateral scission is rather more apparent than in the two preceding species. The branchial plumes and all the other organs are in exact accordance with the type, *M. gracilis*.

The shells exhibit two well-marked varieties; the one the typical *M. linearis*, with more regular subdued spiral striæ; the other is more scabrous. The smoother variety is sparingly found in the coralline zone; the scabrous shells are abundant in the same zone, at Exmouth. I have only examined the animal of the latter; it is possible the former may be distinct. —Exmouth, 3rd August 1850. Since writing the above I have met with a fine live specimen of the smoother variety, and I am unable to detect a variation in them.

M. ATTENUATUS, Montagu.

Mangelia attenuata, Brit. Moll. iii. p. 488, pl. 113. f. 8, 9; (animal) pl. R.R. f. 5.

This beautiful species is in most respects so similar to the *Murex gracilis*, the type of this section, that to describe it would be nearly a literal repetition of the account of that animal, except that the emargination of the outer lip, which scarcely merits that term, is rather a minute hollow shoot than a scission: there is no operculum. This is a rare animal, but I have examined several from the coralline zone at Exmouth.

Another variation from the *M. gracilis* is, that the foot, when fully extended, is as long as the shell; it is bordered with flake-white spots, but no pink marks are mixed up with it either below or above, as in *M. gracilis*. In this species the only pink or red spots are on the termination of the branchial fold. The organe générateur is of a pea-green colour, and in other respects is precisely similar to that of the type.

No head-veil or inflation interferes with the coalition of the tentacula.

M. COSTATUS, Montagu.

Mangelia costata, Brit. Moll. iii. p. 485, pl. 114 A. f. 3, 4, 5; (animal) pl. R.R. f. 4.

Animal spiral, of seven or eight turns, of a pale hyaline ethereal blue nearly throughout, shaded with the most delicate white. The mantle is of the general ground colour, and even with the shell, except the slight depuratory fold which lies in

the minute canal at the upper angle of the outer lip, and the branchial fold that lines the basal canal and floats far beyond it: the prevailing ground colour is sprinkled with minute sulphur-yellow flakes. The head is small, compressed, almost obsolete, and from the vertical fissure under it the usually armed proboscis is exserted. The tentacula are moderately long, with eyes placed externally on offsets half their length; the terminal portions are slender, setose, and slightly clavate at the tips. The branchiæ and other organs offer no variations. The foot is pale ethereal blue, with a transparent white narrow border, in front truncate, slightly indented, labiated, and gently curved at the right and left angles into small auricles, narrow, and tapering to a point which extends beyond the spire.

This minute species displays, in its splendid coloration of azure shot with brilliant snow-white streams, and in the proportions of its organs, more deviation than is usually exhibited in this beautiful group, but these elegant distinctions are only specialties. Its habitat extends throughout all the zones. I have had only one opportunity of examining this beautiful minute creature, which being lively, dégagé, and free from shyness, gave me every assistance, and the mate of this lovely Venus may truly apply to it the Ovidian phrase, "non rustica conjux." The Scotch specimens are of larger growth than those of more southern climes.

Exmouth, 20th August 1850. I have just met with several live animals in the littoral zone, and I find that in the males the organ of reproduction is exactly the same as in the type.

M. PURPUREUS, Montagu.

Mangelia purpurea, Brit. Moll. iii. p. 465, pl. 113. f. 3, 4, 5.

I can only speak of this species from recollection; I examined several of the animals many years ago, but I have not the notes thereon; it is as large or larger than the *M. gracilis*, and if my memory is correct, bears a close resemblance to it; I am certain it has no operculum, and that the emargination in the outer lip is as conspicuous as in *M. gracilis* and *M. teres*. Full-grown specimens are rare at Exmouth. It inhabits the coralline zone.

M. Smithii, Forbes.

Mangelia striolata, Brit. Moll. iii. p. 483, pl. 114 A. f. 1, 2.

Animal spiral, inhabiting a yellowish-brown plicated shell of nine volutions; ground colour white throughout, thickly mixed with opake intense snow-white flakes, and on the siphon with eight or nine bright pink spots. The mantle is rather tumid at the margin of the aperture, and is produced into a short, fleshy, rather open or scoop-shaped branchial fold, which, on the march, is carried somewhat beyond the termination of the canal; it also lines the anal sinus at the upper angle of the outer lip, which some authors term a pleurotomic scission. The head is the usual flat muricidal one, having at its centre the vertical fissure from which the ordinary armed proboscis is emitted. The tentacula are short, and the portions as far as the offsets, on which the large black eyes are fixed externally, are thick and strong, but the continuations are exceedingly short fine filaments.

I consider the present, of all the species I have examined, as that which has the eyes nearest the points. The foot is exactly truncate in front, and scarcely eared at the external angles; in repose it is puckered and rounded posteally, but on the march it extends to a tolerably lanceolate termination. There is no longitudinal line on the sole, nor trace of an operculum; it is bevelled laterally from the long pedicled base by which it is fixed to the body, and also slopes from the anteal truncation to a sharp edge.

The animal is rare at Exmouth, and inhabits the coralline zone; it is extremely free, and gives every facility for examination; it scarcely differs from *M. attenuatus*, or the type, *M. gracilis*.

It appears that the *Murices* of this section, none of which much exceed an inch in length, are all without opercula, and have erroneously been considered the *Pleurotomata* of Lamarck, who constituted the genus *Clavatula* for some of the species, but afterwards abandoned it. The true *Pleurotomata* have all a deep sinus or emargination in the upper angle of the outer lip of the shell, and a corresponding scission in the

mantle of the animal, and the foot is invariably furnished with an operculum. We have shown that the British *Pleurotomata* are almost always without opercula; the genus has scarcely a malacological support; it rests solely on the emargination in the upper part of the outer lip and the corresponding sinus of the mantle, which, in the British species, is not cloven, as in the true exotic *Pleurotomata*. These slight characters, whether of the shell or the animal, so far from being essential permanent ones, are most variable and uncertain, shading off in the numerous species, from the deep pleurotomic scission into the simple, scarcely perceptible canal of the *Murices* of our second section, the *Fusi* of authors. No one can define the boundary of this arbitrary generic index, which in many species does not even indicate specific variation.

Dr. Leach placed them in his genus *Mangelia*, for what reason does not appear, but I can see nothing in those I have described to justify the creation of a genus for their animals distinct from *Murex*. I view them as *Murices* in which the opercula have vanished or become obsolete; I have therefore placed them as the last section of the genus *Murex*, considering them as on the confines of the family, and forming the passage to the exotic genera *Cancellaria, Dolium, Harpa, Mitra, Voluta*, and *Conus*, all of which, except *Conus*, which has a minute operculum, are without that appendage; and though these families are not the typical Canalifera, still it is clear that the *Columellariadæ* and *Convolutidæ* have very many points of connection with the *Muricidæ*. In this section there are two or three British species, the animals of which have not occurred to us; amongst them, the *Pleurotoma teres*, nonnull., which is placed here provisionally, being the only British species without longitudinal ribs: the animal may be the true exotic *Pleurotoma* with an operculum; the character of the scission is peculiar, and more in accordance with that genus: its position must remain in doubt until the soft parts have been examined.

We have recently learnt that the *M. teres* and *M. Leufroyi*, the *Boothii* of authors, have no operculum, and consequently

belong to this section, and also *M. Trevillianus*, *M. turricula*, *M. rufus*, and *M. nanus*, none of which we have met with alive. We refer to figures of them.

M. TERES, Forbes.

Mangelia teres, Forbes et Brit. Moll. iii. p. 462, pl. 113. f. 1, 2; (animal) pl. R.R. f. 3.

M. LEUFROYI, Michaud.

Mangelia Leufroyi, Brit. Moll. iii. p. 468, pl. 113. f. 6, 7; (animal) pl. R.R. f. 1.

M. NANUS, Lovèn.

Mangelia nana, Brit. Moll. iii. p. 461, pl. 112. f. 8, 9.

M. TURRICULA, Mont.

Mangelia turricula, Brit. Moll. iii. p. 450, pl. 111. f. 7, 8; (animal) pl. T.T. f. 2.

M. RUFUS, Mont.

Mangelia rufa, Brit. Moll. iii. p. 454, pl. 112. f. 3, 4, 5; (animal) pl. T.T. f. 4.

M. TREVILLIANUS, Turton.

Mangelia Trevilliana, Brit. Moll. iii. p. 452, pl. 112. f. 1, 2.

I have to say a few words on the gland which is seen in many species of the *Muricidæ*, and is conspicuous in the *Murex lapillus* (*Purpura* of authors), and which has been considered by naturalists to be the organ that produced the ancient far-famed Tyrian purple dye. The gland is of a white or green colour; it lies between the mucous fillets and the ovarium on the right side of the animal; it is of linear form, and though in some species it appears of a dark green colour, the juice or secretion, when extracted and exposed to the air and sun, assumes a purple hue. It is doubtful from what species this famous dye was obtained; it can scarcely have been from the *Murex lapillus*, as Lamarck's commentators say that species does not inhabit the Mediterranean—

. . . . " Tyrioque ardebat Murice læna."
. . . . " te bis Afro
Murice tinctæ
Vestiunt lanæ" . . . .
. . . . " Vestes Gætulo murice tinctas."

From these quotations it appears that the costly purple dye was an African production, and not obtained from the European coasts of the Mediterranean. Horace mentions the *Murex* of the Italian shores—

"Murice Baiano melior Lucrina peloris."

This *Murex* of the Baiæ may be our *M. erinaceus*, the *M. undatus*, (*Buccinum undatum* auctorum,) or any other species; it is not spoken of in connection with a dye, but as an edible shell-fish, inferior to the *Peloris* of the Lucrine lake: what this may be is quite conjectural.

It must have been observed that the descriptions of the numerous Muricidal species are so similar as to give the idea of ringing the changes on the various organs, and it would appear that we have only exhibited the portraiture of a single animal inhabiting all the species that have been mentioned. If this view is acquiesced in, I shall have accomplished the object of my preliminary proposition, viz., that the Linnæan genera *Murex* and *Buccinum* have been dismembered to an extent far beyond the requirements of the progress of science.

I conclude by observing that it may be objected, that I have dispensed with all considerations of the figure and markings of the shell as contributing to generic distinction. I admit this position, as I am of opinion that when the animals of a group are identical in essentials, the greater or less tumidity and the smooth or varicose aspect of the external hard parts are only specific indices arising from the various dispositions of the mucous glands of the mantle. I consider the causes I have mentioned, of the different aspects of the shells inhabited by similar animals, in no other light than the different aspects of the organs of the human race, which arise from similar agents, as the ever-varying disposition of the superficial veins, of the pores, absorbents, and other emunctories, combined with climate, food, and peculiar habits.

With regard to malacology, I am strongly supported in these opinions by having in my cabinet a large series of all the varieties of the *Murex undatus* (*Buccinum undatum*

auctorum), in which we see the smooth, thin, fragile, slender and fusiform varieties shadowing gradually to their various forms, from the thick, heavy, strong, ridged, undated, varicose typical *Murex undatus*. The series I speak of are the identical shells of Professor William King, which have passed into my hands, and were the illustrations of his valuable malacological paper in the 18th volume, p. 248, of the 'Annals of Natural History,' the perusal of which I earnestly recommend to naturalists, as he has therein demonstrated that in this species the singular and great deviations of form, as the slenderness, tumidity, markings, &c., do not arise from generic distinction, but from the influences of climate, habitat, food, and bathymetrical considerations.

If these views are valid, they explode the long-held opinion that external form and markings ought to be regarded as unerring elements of *generic distinction*; and our observations appear sufficiently to prove that this doctrine has too long been insisted on, even in animals of essentially similar structure, both of the external soft parts and internal anatomy.

CYPRÆADÆ.

The British species of this family are distributed in *Cypræa*, *Marginella*, and *Ovula*, which form part of Lamarck's *Columellaridæ* and *Convolutidæ*. *Marginella* is not entirely rolled on itself, as it has a short exserted spire. The canals at the base of the aperture of these genera are little more than emarginations. Many years since we examined the animals of *Marginella* and *Ovula*, but the notes have nearly escaped our memory, except that they are undoubtedly deposited correctly as members of the *Cypræadæ*. The last two species were obtained in the coralline zone at Exmouth twenty years ago, the *Ovula patula* even plentifully, but my dredger has not taken a live specimen of either for many years. The animals are of the Muricidal type, and the chief peculiarity is, that the last-formed volution of the shell envelopes its

predecessor, so as almost to obliterate the traces of a spire, which is very short in *Marginella* and *Ovula*, and entirely concealed in the adult *Cypræa*. None of these genera have an operculum, and the mantle in all is largely reflexed on the shell. This family terminates the British Muricidal group.

CYPRÆA, Linnæus.

C. EUROPÆA, Linnæus.

C. Europæa, C. pediculus, C. arctica, Auct.
C. Europæa, Brit. Moll. iii. p. 495, pl. 114 A. f. 6–9; (animal) pl. N.N. f. 5–7.

Animal inhabiting a strong, suborbicular, transversely-ribbed, white or pale flesh-coloured convolute shell. The mantle is very large, and can be reflexed on both sides so as to cover the entire shell; it is marked for some depth with alternate red, brown and white transverse stripes, sprinkled sparingly with minute sulphur-yellow well-raised papillæ. The branchial fold extends beyond the shell, and is edged with orange-colour, marked on its surface with fine yellow lines, mixed with a few brighter dots, with its terminus more intensely yellow. The head is scarcely a projection, concave laterally, flat above, and from its central basal vertical fissure a long proboscis can be exserted, though it is rarely seen; the palate is immediately within it, enclosed by two transparent yellow corneous plates, between which a short spinous tongue proceeds to the stomach. Behind the buccal mass is the nervous cordon of two oval orange-coloured ganglia. The tentacula are pale yellowish-white, marked with five or six intensely yellow, flaky, minute dots; they are long, slender, round, tapering to rather a short obtuse point, greatly divergent, with eyes on very short pedicles at the external bases. The foot when in action is long, narrow, and rounded in front, yet slightly auricled, slender behind, but not very pointed, and extending considerably beyond the shell; in the middle portion it is bluish-white, but posteally and anteally of a pale orange-brown, with a few small bright sulphur patches. The bran-

chial plume is a large, brown, finely pectinated, half-moon-shaped plate of two segments, each appearing to have a branchial artery. The organe générateur is large, spatulate, and lies doubled up on the right side. The liver is dark brown. The coloration of these animals varies much, but in those individuals in which it is highly concentrated, one can scarcely behold a more gorgeous creature.

It is a littoral and coralline zone species, but the animals and shells found in the former are of a darker hue, and the hard parts marked on the back with two or three black spots. The deep-water ones are smaller, of a pale blush colour, and without the dark spots; they are varieties dependent on habitat, and both are abundant.

This is the only British species, and from its close affinity to *Ovula* and *Marginella*, both as to its anatomy and the external generalities of the soft parts, would almost serve in that respect as the type of either of the genera.

The *C. bullata* of authors is the young *Cypræa*, in which state it shows a spire, and is more or less unrolled, being hyaline, smooth, and destitute of ribs in proportion to its youth.

MARGINELLA, Lamarck.

M. LÆVIS, Donovan.

M. lævis, Brit. Moll. iii. p. 502, pl. 114 B. f. 4, 5; (animal) pl. N.N. f. 8, 9.

Cypræa voluta, Montagu.

This genus is the *Erato* of Risso. It is distinguished from *Cypræa* and *Ovula* by the short exserted spire, and of course is not strictly convolute; it is therefore placed by Lamarck as one of his *Columellariadæ*. The margins of both lips have a longitudinal row of minute pliciform eminences. The animal reflects the mantle on both sides, so as nearly to cover the shell; it is also formed into a free, floating, branchial canal. The head is little more than a vertical fissure for the issue of a proboscis. The tentacula are long, slender, approximate, with eyes on external, short, obtuse pedicles. The foot is like

that of *Cypræa*, extending beyond the shell. The mantle is aspersed with yellow papillæ, and the body with light pink blotches; the sole of the foot is ash-colour. Not being in possession of our original notes, we have had recourse to memory and the 'Enum. Moll. Sicil.' of M. Philippi. It appears that the animal scarcely differs from *Cypræa*.

OVULA, Bruguière.

O. PATULA, Pennant.

O. patula, Brit. Moll. iii. p. 498, pl. 114 B. f. 1, 2; (animal) pl. N.N. f. 1–4.

O. acuminata ? Brit. Moll. iii. p. 500, pl. 114 B. f. 3.

The shell preserves the same figure at all ages. The mantle is dark, reflexed largely over the shell on both sides; it is smooth, and not, as in *Marginella* and *Cypræa*, aspersed with papillæ. The branchial fold does not extend much beyond the margin of the hard part. The tentacula are long, slender, approximate, obtuse at the tips, dark, and form at their base external tubercles on which the small black eyes are set. The foot is longer and wider than the shell, truncate in front, with a longitudinal mesial groove on the sole; it is pale brown, as are the head and the bases of the tentacula.

We have seen fifty of these animals alive, but being deprived of our notes, we are indebted for the above, in part, to M. Philippi, which assistance, with the reference to the account of the animal of *Cypræa*, from which the present species scarcely varies, will suffice for an *ad interim* notice, as we confidently expect to supply another from personal observation. We believe the *O. acuminata* is the young of this species; some of our brethren dissent from this view, which we shall not abandon until the discovery of the animal shows that we are in error.

I conclude by presenting a view of the numerical status of these animals. After a careful examination, I believe I shall not much err in the following estimate:—

Marine testaceous Acephala	152
Marine Gasteropoda	205
	357
Deduct the doubtful species . .	21
Net amount	336;

of which I have described nearly two-thirds, a number far exceeding those recorded in works on this branch of zoology. I trust that some energetic naturalists will complete the tale; a noble harvest and much fame await them. Many species are wanted from *Caledonia*: as a Southron, I invoke the men of the North to supply them. Let a description of every desideratum be instantly committed to our 'Annals,' and we shall soon show the continental *savans* that we have profited by their example, and convince them that we have wiped away the opprobrium cast on us, of being mere shell-gatherers, instead of observers of the living elements of nature. These pages will prove how greatly the sphere of any branch of zoology may be enlarged by every votary of the science doing his duty in his particular locality.

Some conchologists, with the aid of a hundred and twenty land and freshwater species, the exotics, and British pseudo-species, have raised our list to eight hundred, and even a thousand; but I think it will be long before our reformed roll will, with the land and freshwater species, amount to five hundred. I add an alphabetical list of the exotic species which have so long choked up our indigena, and refer the collector for more extended information to the excellent notes of the learned authors of the 'British Mollusca' on the spurious species that have been foisted on this branch of science by negligent and over-zealous observers, who have been misled by hearsays, and have not sufficiently allowed for the exaggerations of common report, forgetting the aphorism of the Mantuan bard—

"Vires acquirit eundo."

LIST

OF THE

EXOTIC SPECIES WHICH HAVE BEEN IMPROPERLY ADMITTED INTO THE BRITISH FAUNA.

Arca { barbata, reticulata, } *Turt., Brit. Moll.*
—— rostrata, *Mont., Turt.*
? Astarte arctica, *Brit. Moll.*
? —— crebricostata, *Brit. Moll.*
Buccinum ambiguum, *Mont., Turt.*
—— bilineatum, *Mont.*
—— cinctum, *Mont., Turt.*
—— decussatum, *Pennant.*
—— glaciale, *Mont., Turt.*
—— hepaticum, *Mont., Turt.*
—— lineatum, *Mont., Turt.*
—— perdix, *Mont., Turt.*
—— pictum, *Brit. Mar. Conch.*
Bulla alba, *Brit. Mar. Conch.*
—— ampulla, *Mont., Turt.*
Cardium arcuatum, *Mont., Turt.*
—— lævigatum, *Brit. Mar. Conch.*
—— medium, *Mont., Turt.*
—— muricatum, *Fleming.*
Cingula Bruguieri, *Brit. Mar. Conch.*
? Corbula ovata, *Brit. Moll.*
? —— rosea, *Brit. Moll.*
Crenatula Travisii, *Turt.*
? Crenella faba, *King, Müller.*
Crepidula sinuosa, *Turt.*
Dentalium album, *Turt.*
—— semistriatum, *Turt.*
Dentalium striatulum, *Mont., Turt.*
Donax denticulatus, *Mont., Turt.*
—— plebeius, *Mont., Turt.*
—— trunculus, not *Mont.* or *Turt.*
Fusus lineatus, *Brown.*
Haliotis tuberculata, *Linn.*
Helix decussata, *Mont.*
Hyalea trispinosa, *Brit. Moll.*
? Hypothyris psittacea, *Turt.*
Lithodomus lithophagus, *Brit. Mar. Conch.*
? Lucina divaricata, *Auct.*
Mactra dealbata, *Mont., Turt.*
—— deaurata, *Turt.*
? —— { glauca, helvacea, } *Mont., Turt.*
—— radiata, *Mont., Turt.*
Melania Matoni, *Gray.*
? Modiola Ballii, *Brit. Moll.*
Murex accinctus, *Mont., Turt.*
—— carica, *Turt.*
—— carinatus, *Turt., Pennant.*
—— despectus, *Mont.*
—— duplicatus, *Donovan.*
—— fuscatus, *Mont., Turt.*
—— gyrinus, *Mont.*
—— sinuosus, *Mont.*
—— subulatus, *Mont., Turt.*
Mya decussata, *Mont., Turt.*

Mya glycimeris, *Mont.*, *Turt.*
—— nitens, *Mont.*, *Turt.*
Mytilus crenatus, *Hanley.*
—— fuscus, *Turt.*
—— plicatus, *Mont.*, *Turt.*, *Laskey.*
—— striatulus, *Turt.*
—— ungulatus, *Mont.*, *Turt.*
Nerita canrena, *Mont.*, *Turt.*
—— intricata, *Donovan.*
—— sulcata, *Turt.*
—— tuberosissima, *Mont.*, *Turt.*
Orbicula striata, *nonnull.*
Ostrea crista-galli, *Mont.*, *Turt.*
? Pandora rostrata, *Auct.*
Patella antiquata, *Mont.*, *Turt.*
—— intorta, *Mont.*, *Turt.*
—— militaris, *Mont.*, *Turt.*
—— nubecula, *Turt.*
? Pecten islandicus, *Turt.*
—— Jacobæus, *Mont.*, *Turt.*
Petricola lithophaga, *Brit. Moll.*
Pholas striata, *Mont.*, *Turt.*
Pinna muricata, *Mont.*, *Turt.*
Psammobia declivis, *Turt. Conch. Dithyra.*
? Scalaria groënlandica, *Auct.*
? Skenea rota, *Brit. Moll.*
Solen declivis, *Turt. Conch. Dithyra.*
—— fragilis, *Mont.*, *Turt.*
—— strigillatus, *Turt.*
Strombus costatus, *Turt.*
Tellina bimaculata, *Mont.*, *Turt.*
—— carnaria, *Mont.*, *Turt.*
—— fausta, *Mont.*, *Turt.*
—— fragilis, *Fleming.*
—— inæquistriata, *Donovan.*
—— Laskeyi, *Mont.*, *Turt.*
—— lineata, *Mont.*, *Turt.*
—— pisiformis, *Mont.*, *Turt.*
? —— proxima, *Brown.*
—— punicea, *Brit. Mar. Conch.*
Tellina reticulata, *Turt.*
—— similis, *Mont.*, *Turt.*
—— striata, *Mont.*, *Turt.*
Teredo bipennata, *Turt.*
—— malleolus, *Turt.* ?
—— palmulata, *Brit. Moll.*
Triton cutaceus, *Turt.*
—— elegans, *Auct.*
Trochus cinereus, *Mont.*, *Turt.*
—— conulus, *Turt. Brit. Mar. Conch.*
Turbo Bryereus, *Mont.*, *Turt.*
—— calathiscus, *Mont.*, *Turt.*
—— calcar, *Mont.*, *Turt.*
—— cinctus, *Mont.*, *Donovan*, *Turt.*
—— coniferus, *Mont.*, *Turt.*
—— denticulatus, *Mont.*, *Turt.*
—— dispar, *Mont.*, *Turt.*
—— duplicatus, *Turt.*, *Donovan.*
—— mammillatus, *Mont.*, *Turt.*
—— marginatus, *Mont.*, *Turt.*
—— terebra, *Donovan.*
—— tuberculatus, *Pennant.*
—— ziczac, *Turt.*
Venus deflorata, *Mont.*, *Turt.*
—— Dysera, *Mont.*, *Turt.*
—— granulata, *Mont.*, *Turt.*
—— guineensis, *Mont.*, *Turt.*
—— orbicularis, *Mont.*, *Turt.*
—— pallida, *Turt.*
—— Paphia, *nonnull.*
—— subcordata, *Mont.*, *Turt.*
—— subrhomboidea, *Mont.*, *Turt.*
—— substriata, *Mont.*, *Turt.*
—— sulcata, *Mont.*
—— tigerina, *Mont.*, *Turt.*
Voluta bullaöides, *Mont.*
—— catenata, *Mont.*, *Turt.*
—— hyalina, *Mont.*, *Turt.*
—— pallida, *Mont.*, *Turt.*
—— triplicata, *Mont.*, *Turt.*

APPENDIX.

During the progress of this work through the press, we have been enabled to submit many of the animals referred to in its pages to a careful re-examination, which has in some few instances shown that our original impressions were partially incorrect, and in others has caused us to modify our opinions to a greater or less extent. The results of such observations as were made too late to be incorporated in the body of the work, are contained in the following Appendix.

Scrobicularia piperata.—(P. 138.)

Exmouth, July 1854.

As my original notes upon this animal were but scanty, I have gladly embraced an opportunity of making a fresh examination of its structure, particularly as it presents a very unusual configuration of the branchiæ and palpi.

I find that these organs are of the palest brown, with a slight red cast. The palpi are regularly triangular, pointed, enormously large as regards length and breadth, comparatively smooth without, and strongly striated within. There is only a single branchia on each side the body, of a broad triangular shape, very thick, fixed by the longest side to the posterior dorsal range, with the angular point vertical to the ventral line; it is divided diagonally, by a subcentral narrow groove, into two subtriangular portions, whereof the one nearest the dorsal slope is usually the least. Instead of one part folding on the other, as in the regular two-leaved branchiæ, it is thrown back and pinned to the posterior dorsal slope, forming one moderate branchial plate, certainly not much

larger than one of the palpi. Each branchia unites with its fellow at the posterior dorsal extremity, and also in the middle of the dorsal line; it effects, on each side, a very slight junction with each pair of palpi. If that part of the branchial plate which is reflected back and fixed, were free, it would range and lap on its fellow portion, and thus constitute the normal pair of branchiæ. If this view is correct, we ought to consider the single plate as essentially a double one, though its component parts are abnormally arranged. The mantle is open on the ventral surface, with the margin irregularly scolloped. The liver is dark green. The ovarium at this season is studded with young, and occupies the entire surface of the body between the liver and the foot.

At one time, from the character of the hinge, we were of opinion that *Scrobicularia* might have been associated with *Syndosmya*, but finding the branchiæ and palpi of the two so very discordant, we abandoned that idea; we now think that the genus is superfluous, and that its single species may be transferred with great advantage to the same section of the *Tellinæ* as *T. solidula* and *T. tenuis*, with which it agrees as to the soft parts almost precisely; whilst in the hard parts it only differs in having a semi-internal cartilage, which with us is a point of little or no importance.

Pandora obtusa.—(P. 150.)

Exmouth, July 1854.

In our original account of this species, published in Forbes and Hanley's Brit. Moll. vol. i. p. 211, we stated, that there were two palpi, one branchial lamina, and an obsolete one on each side the body; from subsequent observations we were induced to modify our opinion, thinking that there were two perfect branchial plates on each side. A further examination of the animal has proved, however, that our original impression was substantially correct, as the following description will show.

The animal has two very short, reddish-brown, subtriangular palpi, blunt or rounded at their termination, which often

cover each other so closely as to be mistaken for one; but this is not always the case. It is difficult to separate the two plates, even when floated; we have, nevertheless, often succeeded, and have a preparation which is indisputably decisive of their duplex character. There is one thick, rather narrow, elongated branchia, and a rudimentary one on each side of the body, and not two entire plates, as mentioned in former notes. The green liver is conterminous with the pale red-brown ovarium, which at this period is filled with ova.

It appears to be a *non sequitur* that a single branchia on each side should be accompanied by a corresponding single palpum. We apprehend all bivalves must have two palpi on each side, as purveyors of aliment to the mouth, whether the branchiæ be single or double.

Pholas dactylus.—(P. 192.)

Since the letter here printed was written, several papers have appeared in the 'Annals,' which largely support, and partly impugn, our theory of the action of the branchiæ in the Bivalves.

Dr. Sharpey's original views on the permeability of the gill-laminæ in the Acephala, have, after a lapse of more than twenty years, again been prominently brought forward. It was our lot to become fully cognizant of his discovery in 1834, that is, soon after it was promulgated, as it appeared in vol. vii. p. 108 of 'Loudon's Magazine of Natural History,' to which we subscribed, and it has, as late as 1850, again been mentioned in Dr. George Johnston's excellent volume, entitled 'An Introduction to Conchology'; but considering Dr. Sharpey's views erroneous, and physiologically impossible, we dismissed them from our thoughts.

Messrs. Alder and Hancock have also announced an essentially similar scheme, as based on original observations; but this condition has been withdrawn in a paper by Mr. Alder in the 'Annals of Natural History,' vol. xiv. p. 131, N. S.

And lastly, Dr. Thomas Williams, in a series of memoirs published in 1854 in the above work, on the aquatic respiration of the Invertebrate animals,—we particularly allude to those on the Mollusca,—has adopted Dr. Sharpey's theory,

with the addition of a mass of the most minute anatomical and functional details—to us so incomprehensible, that we have given up the attempt to unravel them.

The key-stone of the theories of these gentlemen is the assumed permeability of the acephalan gill-laminæ. I believe that this determination will prove erroneous. I am, of course, open to conviction, but I think my position founded on the rock of "magna est veritas, et prævalebit."

Under these circumstances I cannot, in the present phase of this question, withdraw a single position of the branchial theory I have proposed.

Anatomy, even the microscope, chemical tests, and the most ingenious experiments, have hitherto failed demonstratively to solve this long-vexed question; all our attempts amount to little more than hypothesis, intrepid assertion and assumption, which often simulate facts, and pass for proofs.

Dentalium Tarentinum.—(P. 235.)

I have stated that "M. Deshayes has omitted to mark the vein which runs at the dichotomous points of his organ, which, when viewed under high powers, is very visible, and which I take to be the branchial vein."

I withdraw this observation, whether my conjecture be correct or not, as it would have been inconsistent in that naturalist to figure a branchial vein in an organ considered by him to be the liver.

His liver is our branchiæ. We have lately re-examined the *Dentalium Tarentinum*, and we almost think that the artery and vein have a nearly parallel position on the dorsal line, as in the Bivalves. The tumid cord-like appearance of the lower border of this minute organ has perhaps led to an erroneous conclusion.

Chiton cancellatus.—(P. 251.)
Chiton albus.—(P. 251.)

Though the above are admitted as distinct species, we are now bound to add, that this determination must be considered provisional; there is reason to believe that both these forms

are nothing more than the young conditions of *Chiton asellus*, which varies much in the dimensions of its longitudinal and transversal areas, as well as in the density and regularity of the linear punctated sculpture. Or we must conclude that these species are not in our collection, though we have been assured by good conchologists that our shells represent them.

Since writing the above we have dissected specimens of both the so-called species, and found all the separate valves finely *crenulate*, not emarginate; thus confirming the opinion that our shells are *C. asellus*. Therefore if Mr. Lowe's *C. aselloides*—the *C. albus* of authors—is bi-emarginate on each side the valves, it cannot belong to the present species. It has however been suggested, that it may be a young, white, finely granulated *C. cinereus*; we should have concurred in this view if it had not been opposed to so accurate an observer as Mr. Lowe.

Our so-called *C. cancellatus* has the same finely crenulated margins as *C. asellus*, which is, we believe, the only British species thus sculptured.

TROCHUS SERPULOIDES, p. 314; TR. CUTLERIANUS, p. 315; TR. NITENS, p. 316.

Exmouth, 10th July, 1854.

I have much satisfaction in stating, that the process under the right tentaculum in these very minute species, which is figured in a woodcut in the 'Annals of Natural History,' vol. viii. p. 45, N.S., and styled "*genitale*," has not that function. I am the more pleased with this discovery, as no such organ is to be found in that position in the large *Trochi*; and as these minute animals agree with their larger brethren in all other respects, I was puzzled to account for this discrepancy. The difficulty is removed by finding that the process I have alluded to is part of the right neck-lappet, which is bifid; both of its strands spring from the same membrane, as I have seen clearly in a brilliantly transparent *Trochus nitens* under high powers. The right neck-lappet is always longer than the left, which however is also bifid, but plain, and never ornamented, fringed or serrated, as is sometimes seen

in the right one, for instance in *Tr. serpuloides*. The same inequalities exist in the neck-lappets of the larger *Trochi*. I have thus removed all aberrations between the organs of the larger and these minute but perfect Trochidans. I believe there are only three vibracula on each side the opercular lobe, instead of four as I have elsewhere stated, but I do not vouch that there may not be four in one of the above species.

Phasianella pullus.—(P. 320.)

Exmouth, July 1854.

As I have several important additions and corrections to make in my account of this animal, I have thought it best to give a general description of it, as the alterations will thereby be rendered more intelligible.

Shell of five obliquely striated, almost smooth, tumid, porcellanous volutions, separated by a fine sutural line, variously painted with all imaginable hues of colours, forming in many specimens a splendid *tout ensemble*: the body whorl equals in size all the rest. The aperture is suboval, outer lip sharp, and much advanced beyond the columellar side.

Animal.—The mantle exactly lines the shell, and is of the palest hyaline sea-green. Muzzle very short, cylindrical, finely wrinkled, mottled with red-brown blotches, sometimes marked with transverse green stripes, and at others with longitudinal streaks of the same colour, on a yellow or pale red ground; its termination or disk is subcircular, finely serrated at the margin, and has a crosial oral fissure; from this the animal often protrudes the corneous jaws, which with the lingual riband are supported by greenish fleshy plates; the under surface of the disk is marked with red streaks on a white ground. The tentacula are pale yellowish-white, long, pointed, flattish, crowded with fine setæ, and are in constant vibration. The eyes are external, on distinct yellow, white, or green pedicles. The neck-lappets are white, pale, or grass-green subcircular membranes; the right is the largest, margined with 12–15 distinct white or green cirrhi, of almost equal length, and fimbriated at the sides; the left has only

8–10 cirrhi. The colours described are those of the animals examined; they vary greatly, and in individuals exhibit all the shades of red, pink, purple, brown, maroon, bistre-yellow, and all the greens.

The foot is long and narrow, with a tumid aspect on the upper surface, rounded in front, without a trace of auricles, obtusely lanceolate at the posteal end, and marked above with red-brown, zebra-like, or narrow, longitudinal, wavy lines; the sole is yellow, having a central depressed line throughout its length, and is sometimes coasted on each side by a narrow, bistre-coloured stripe. The operculigerous lobe is almost co-extensive with the foot, of a dark red-brown colour, and largely alated; it is furnished with three densely ciliated, flattish, pointed vibracula on each side; the middle ones are very short and inconspicuous, each bifid, or formed of two strands: with powerful glasses I have never failed to discover them in all the Exmouth examples, and I believe that three on each side is the normal number. The lobe carries a white, highly polished, subcircular, testaceous paucispiral operculum, concave within, convex without, and fixed on the posterior extremity about midway. This animal has the peculiar littorean oscillatory quality of progression, which, with the paucispiral operculum, seem to mark it as a transition genus from the *Trochi* to the *Littorinæ*; we, however, must admit, that by the vibracula and neck-lappets it has a close connection with the *Trochidæ*. I am puzzled about the reproduction, on which account I can only at present refer to the original notes. No exserted verge has been detected, and though placed in our first account, provisionally, with the *Trochidæ*, I rather think, by the character of the operculum, it is bisexual, and that in a comparison of the two genera, the balance preponderates on the side of *Littorina*.

It is sometimes infested with a longish, strong, cylindrical, dark brown parasite, with a clavate termination, which hangs to the side of the opercular lobe, and may be mistaken for a vibraculum.

Cæcum trachea.—(P. 327.)

The tentacula are not short, as originally stated, but com-

paratively long, divergent, thickened, and a little spread at the bases; the eyes have decidedly an external bias. The operculigerous lobe is certainly without a cirrhal appendage. The general colour is dull white, saturated with a mixture of minute, confused, snowy, closely condensed matter. The convexity of the arcuation denotes the upper parts of the animal, and the concavity the ventral range.

Turritella communis.—(P. 331.)

Exmouth, July 1854.

The following is the result of another attempt to ascertain the quality of the locomotion of this species. Fifty of these animals, of all ages, were deposited in a large deep dish filled with their *native* soil, which consisted of a tenacious clayey mud mixed with comminuted shelly matter; in this they buried themselves in every position from the vertical to the horizontal. After three or four hours it appeared, from the evidence of a furrow on the mud, that some of these creatures had certainly moved, but the progression was so slow as not to be perceptible by the eye, and was only seen when a short space had been passed. From this experiment it would seem that this species has the faculty of effecting a very slow march. This inaptitude for motion arises from the shortness of the foot, not from the length of the shell; as in other animals with elongated shells, such as some *Chemnitziæ* and *Eulimæ*, the progression is sufficiently active.

Rissoa fulgida.—(P. 357.)

Exmouth, July 1854.

This description is entirely reproduced from lively animals just examined. The species was originally described by us for the 'British Mollusca,' but its almost microscopic size caused some of the organs not to be precisely appreciated.

The shell has four rounded, deeply separated, smooth volutions, which are spirally encircled by two dullish, red-brown fasciæ, varying in breadth on the three basal turns, with a yellow one running between them and filling up the inter-

mediate space. The aperture is suborbicular, not thickened at the outer margin as in the *Rissoæ*, and almost entire. The umbilicus is conspicuous. Axis $\frac{1}{25}$, diameter $\frac{1}{35}$ unciæ.

Animal. — Ground colour of the palest muddy yellow. Mantle even with the shell. Muzzle short, smooth, thick, though flat above, cloven at the end, mouth beneath, with a vertical fissure. Tentacula finely setose, divergent, flat, rather slender, gradually tapering from base to point, which is rounded, hyaline-white, suffused with minute snowy points; eyes large, but rarely exserted, placed on low prominences at the external angles of the tentacula. The foot has three phases; when at rest it is rounded anteally, and still more so posteally; when the animal swims it becomes narrow and rounded to a similar extent and form at both ends; on the march it is arched convexly in front, not auricled, and posteally has a blunt lancet-shaped termination; the sole is deeply impressed with a longitudinal central line; the opercular lobe is short, but laterally alated, and carries, near the extremity, a grossly spiral, yellow, rissoidean, subcircular, corneous operculum, which has been described as not spiral. This is an error. In clean examples under the microscope, the depressed nucleus and usual spiral turn may be traced; a dozen examples have been examined, and though obsoletely impressed, they are clearly paucispiral. There is no distinct cirrhus springing from the operculigerous lobe, but in some specimens I have fancied I saw a very short blunt one. Sometimes the point of the main sole is bifid for a very short distance. The animal is most abundant on the littoral levels at Exmouth; it marches with great rapidity, and is vivacious and free; on the march the eyes are always under the shell, as are usually the muzzle and foot, the ends of the tentacula only being visible; it carries its shell at an angle of 70°. I have elsewhere stated that this species can scarcely remain in the genus *Rissoa*, but these various rectifications induce me to withdraw that opinion; it really appears to have as many or more rissoidean attributes than some of the species admitted into that genus.

Rissoa striata.—(P. 360.)

Exmouth, July 1854.

In our original notes it is stated that there is no cirrhus on the opercular lobe at its termination. Having reviewed a fine lively specimen, we found, beyond dispute, a short, white, pointed caudal filament. The pendent minute fillet at the upper and external angle of the aperture is present, though, as it is usually withdrawn, it cannot always be detected. The front of the foot forms a deep labium at the upper part by its separation from the sole; the flap is of the shape of the letter V inverted, the basal points being in front, and the angular one posterior; it is shadowed out by its flake-white composition, which is visible through the pellucid sole; but the most singular feature is, that its margins throughout are largely disunited from the upper part of the foot, being only fixed thereon by a central attachment. I have never before observed a similar labial structure, though it may exist in other animals and have escaped notice, for the foot in all the Gasteropoda is more or less labiated.

Rissoa costata.—(P. 362.)

Our notes are exact; in a specimen examined in July 1854, we cannot detect the filament we failed to find in 1852, at the upper angle of the aperture. Can it, instead of proceeding from the mantle, as supposed by us, issue from the neck, and be the *genitale* of these minute creatures, which are considered bisexual? It is certainly much lower under the right tentaculum than is usual. If there is any weight in this conjecture, we must conclude that those species and specimens in which the filament is not visible are the females. What militates against these ideas is, that in some of the *Rissoæ* we have found the organ in every example. This process is certainly not an edge of the operculigerous lobe that occasionally comes into view.

Rissoa soluta.—(P. 365.)

The general colour is hyaline-white, suffused with very

minute points of flaky matter of similar hue. The tentacula are flat and strong, and rather clavate at the tips; the eyes are always carried considerably within the margin of the shell. The foot is narrow, and when fully extended, as long as the shell, with a rather pointed termination. The caudal cirrhus of the opercular lobe is very long and distinct, flattish at its insertion, and tapering to a fine point. This animal is nearly a true Rissoidean. Axis $\frac{1}{25}$, diameter $\frac{1}{38}$ unciæ, in ordinary specimens.

ASSIMINIA.—(P. 380.)

Assiminia is not placed in the same order as in the Classification, it being removed, provisionally, between *Rissoa* and *Truncatella*, as we think, when the animal is better known, it will belong to the latter genus.

We have in vain called on naturalists to furnish us with some of these animals; they abound in the tidal ditches of the Greenwich and other eastern marshes; if they were sent by post on the day of capture, in an ounce bottle filled with the water or moist mud they inhabit, enclosed in a tin cylinder or small wooden box, they would arrive sufficiently lively for examination.

CHEMNITZIA PALLIDA.—(P. 415.)

The rostrum, or head, is short, broad, rounded or subcircular at the end, slightly grooved to its base, and speckled with yellow points. The tentacula are not short, but long, subtriangular, not pointed, and have very distinct, small, flake-white terminal inflations; they are bevelled, rather setose, narrow, not much folded or auriform. The animal, and those of all its numerous varieties, viz. *C. dubia*, *C. alba*, *C. nitida*, *C. albella*, *C. rissoides*, *C. eulimoides*, and *C. glabrata*, are more or less variously suffused with very minute yellow points, as well as speckled with irregularly deposited dots or larger points of sulphur-yellow, of various intensity of hue; this characteristic colouring will always detect the *C. pallida* or any of its varieties, as no other *Chemnitzia* that can be confounded with it is thus painted.

Chemnitzia plicata.—(P. 418.)

Rostrum long, presenting at its termination a flat disk, which exhibits at times the very opposite phases of subcircular and subquadrangular form; it issues from under the coalition of the tentacular membranes, and is attached to the foot by a bridle. The tentacula terminate in rounded sublanceolate points which are very slightly marked with the characteristic apical inflations of the tribe. The half of the rostrum nearest the eyes is thick and wrinkled when not much protruded, and at its upper basal portion, just below the eyes, the proboscidal fissure is apparent. This is one of the species from which I have seen the issue of the retractile proboscis. The foot has very small auricles; on the march it becomes considerably elongated and reflexed upwards, but still retains an obtuse point.

The subcylindrical variety of *C. unidentata* often passes in collections for this species, which is a decided littoral animal. The slender *C. acuta* has also been erroneously considered the *C. plicata*; but this last, and the *C. unidentata*, inhabit the coralline zone.

Chemnitzia acuta.—(P. 420.)

This species shows in a marked manner that the rostrum (the *mentum* of authors) is really the head of the animal. This organ is channelled from its termination to its base, at which point, between and just under the eyes, the fissure is evident, from which I have more than once seen the evolution of a long proboscis. The anteal portion of the rostrum is without any sort of orifice, but it is probably a tentacular aid, and also one of progression. Every one that examines this organ will unquestionably pronounce it the capitular part of the animal, and will discard the term *mentum*.

In many specimens there is a subrotund congeries of 30–40 flake-white points close behind the eyes. The spire of the operculum is more complete than in any other *Chemnitzia* I am acquainted with.

Chemnitzia conoidea.—(P. 422.)

The tentacula have moderately large, terminal, flake-white inflations. The continuation of the upper part of the rostrum with the neck is most apparent and cannot be mistaken, the junction being only invaded by the span of the tentacula and insertion of the eyes. The rostrum is slightly grooved from the point of the emargination to the centre of the tentacular veil, under which, just below the eyes, is the proboscidal fissure.

Chemnitzia rufa.—(P. 423.)

The rostrum is spotted with small flake-white points, particularly on and between its grooved central lines.

The eyes are on the bases of the short, broad, very little folded, triangular tentacula, the tips of which are not decidedly marked with the characteristic apical inflation.

Chemnitzia spiralis.—(P. 425.)

This is a review of the original notes; there is little to add. The rostrum, in quietude, shows an inflation on which the proboscidal fissure may be detected, with the high power of a Coddington lens, in certain lights; when in motion, it loses the finely corrugated prominence, becomes attenuated in the middle, and has a spatulate rounded termination that rarely, when in action, simulates an emargination or hollowing-out.

Chemnitzia interstincta.—(P. 426.)

With regard to the animal inhabiting the shell with flat volutions, we have to add, that when the foot or the rostrum is by excitement produced beyond the usual extent, it becomes greatly hollowed out, and the auricular points increased in length; but this condition is common to all the *Chemnitziæ*, and when tranquillity is restored, the organs revert to the form we have described. The animal is shy and sluggish, and often marches with the eyes under the margin of the shell.

Whether the tumid shell mentioned in our description of

C. interstincta is a variety, or really distinct, may be questionable. This point requires further investigation.

I have stated that the true *C. interstincta* has usually a fold or tooth on the columella, but that it is not uncommonly found without it. I now amend that opinion, and believe it is never without a tooth: the error has arisen from the casual introduction and mixture in collections of young specimens of the *C. indistincta*, which are very similar, but invariably without the tooth. I also remark, that the tumid shell, whether it is a variety of *C. interstincta*, or distinct, is never without the tooth.

With these very minute shells, which closely resemble each other, and whose animals do not differ greatly, first impressions sometimes prove erroneous, but continual examination of both shell and animal at last elicits the truth.

In the reproduction, for "tentacula rather long, slender," read "rather short and broadish." This correction shows the difficulty in these minute creatures, of seizing, in the ever-varying tentacular and other organs, the precise points for description.

Chemnitzia indistincta.—(P. 428.)

We have again examined, in the same vase, the animal of this species, and its variety termed by authors *C. clathrata*, and still retain our original opinion, that they are identical; both vary somewhat in colour, the one having a bluish-white cast, the other a pink one, and they also present different degrees of slenderness and tumidity of contour. Neither has a trace of fold or tooth on the columella.

The rostrum is moderately grooved on its upper surface as far as the basal tentacular coalition, at which point, somewhat below the eyes, a prominence, caused by a slight degree of contraction, marks well the minute fissure for the issue of the proboscis.

Chemnitzia decussata.—(P. 432.)

In this species the rostrum is attenuated in its course from the tentacula to near the termination, where it assumes a

clavate or hammer-like appearance, becoming thick, angular, bevelled to a sudden edge, straight in front, without auricles or central indentation. The tentacula are very short, and their tips less marked and folded than in many others of this tribe.

Chemnitzia clavula.—(P. 436.)

Exmouth, July 1854.

After a lapse of two years, a single, beautiful, lively specimen of this rare species has been met with, which enables me to say that the original notes are correct; I can only add a few minor particulars, which might have been neglected, had I not wished to give naturalists the means of verifying decisively this elegant and very scarce creature.

The tentacula are extraordinarily short and broad, in consequence of the auricular portions that spring from their external margins unfolding and forming a large, fine, arcuated membranous leaf, that terminates just under the apical inflations.

The foot on the march, when the animal is agitated, can be pushed into longish auricles, and in consequence shows a considerable curved hollow in front; this fact is common to all the *Chemnitziæ*, but in deliberate progression it becomes truncate with subdued angular points; the posterior extremity in the example observed was slightly emarginate on the right and left sides, giving the central portion the aspect of a rounded or blunt stylet. On each side of the foot, when the animal is in motion, there is a marginal series of about ten very minute glossy points.

This beautiful creature was remarkably free, and allowed me to see the fine line of the proboscidal fissure on the rostrum immediately below the eyes. It was taken in the same habitat as the original examples.

I have omitted to state above that the foot is constricted gradually below the auricles; it is not narrow, and can, on the full march, be extended to the second basal volution: when that happens, its posteal emarginations nearly vanish.

The apical reflexion of the shell is less pronounced than

usual, not more so than in *C. Gulsonæ*; in these two species it may be termed sunken or subreflexed.

CHEMNITZIA ACICULA.—(P. 439.)

For the corresponding parts in the original notes, read, "Rostrum considerably emarginate in the centre at its anteal termination, forming the angles of the cleft into two minute subrotund processes. The foot is long, often extending on the march to three volutions, and terminating behind in a narrow, produced, lanceolate point. The front of the foot is square, but expands into rather sharp, auricular points, and is gradually constricted below them to the junction with the body".

CHEMNITZIA FENESTRATA.—(P. 440.)

The neck on each side, as far as the tentacula, is marked with a pale lead-coloured stripe, of unequal breadth in its course, which is composed of a close union of very minute points, giving the narrow fillet a mottled aspect. A tinge of the same colour is also apparent on the basal portion of the tentacula and upper surface of the foot. In this species the rostrum is greatly thickened at its base, and with very high powers the proboscidal fissure may be seen; the terminal portion is much compressed, slightly funnel-shaped, and sometimes simulates a cochleariform depression. The apical flake-white tentacular inflations are very distinct.

MUREX GINANNIANUS.—(P. 494.)
MUREX BRACHYSTOMA.—(P. 496.)

The above so-called species have been the source of some controversy amongst naturalists, who have found it difficult to determine their distinctness. With us the "*Ginannianus*" marches with the "*brachystoma*;" the authors of the 'British Mollusca' consider it a synonym of *M. nebula*. We have obtained some specimens of equal size, of our present species, which were deposited in the same glass, and, being lively and free, afforded for some hours an excellent examination, which

demonstrated that the organs of the two objects are absolutely identical in every point as regards anatomical structure. The variations, except in one point, belong to the shells; the *M. brachystoma* is rather more slender, with stronger striæ, more gradually taper, a little flatter on the top of the volutions, and the animal has the flake-white markings on the foot much more densely distributed than in its hitherto considered congener, the *M. Ginannianus*. But under the circumstances of the identity of the organs of the two, and the quality of the markings being undistinguishable under the microscope, I shall account for the numerical difference of the spots by the ungallant assertion of the schools, that the masculine is more worthy than the feminine; and as it is well known that in many animals of the same species the colours and markings of the two sexes vary greatly, they may do so here. I have therefore adopted the opinion, that the more slender shell, termed "*brachystoma*," is the male, and the "*Ginannianus*" the female.

M. Philippi's appellations for the so-called species are contemporaneous; I therefore propose "*brachystoma*" for this animal, as being the more significant, receiving the "*Ginannianus*" as its synonym.

Though the *M. nebula* has close relations with this animal, I think it distinct.

Murex purpureus, Montagu.—(P. 499.)

Mangelia purpurea, Brit. Moll. iii. p. 465, pl. 113. f. 3, 4, 5.

We beg that the following notes of this species may be substituted for those quoted.

Shell.—The specimen observed presented eight spiral, moderately taper, dark purplish-brown, closely cancellated volutions, of about half an inch in length in the whole, with a narrow white band in the centre of the body-whorl. Examples of larger growth inhabit the coralline zone; these are near an inch long, composed of ten turns, which vary in colour from red-brown to pale drab. At the upper angle of the aperture is a distinct sinus or emargination; the margin

of the outer lip is white, thick, sloped to an edge, marked with strong transverse lines within, and occasionally a few of the cancellations are of a white colour.

Animal.—Mantle moderately fleshy, quite white, even with the margin of the aperture, except the exsertion of a not very long branchial siphon, which however often floats beyond the limits of the canal; in the example examined, its colour was pale drab with a tinge of yellow. The head, if it may be said to exist, is of the true muricidal type, scarcely interrupting the junction of the tentacula by the intervention of the proboscidal fissure. The tentacula are of moderate length, formed of strong pedicles of more than half their extent, on which, at the external angles, the large black eyes are fixed; the summital portions are attenuated. The foot is slender, very pointed, and, when extended, as long as the shell (this is not often the case), anteally deeply grooved or labiated, with short, but well arcuated, auricles. The ground colour of the foot and tentacula is subhyaline-white, aspersed with very minute, intense flake-white round spots, not larger than sand points. There is no operculum. The animal is an elegant creature, but singularly apathetic, though observed an hour after capture.

Habitat, in the offing at Exmouth, six miles from the shore, in 10 fathoms water, in shelly muddy sand.

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